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McGRAW-HILL PUBLISHING COMPANY, INC.

August 7, 1926

Half a Century of Mining In the Black Hills

By Francis Church Lincoln

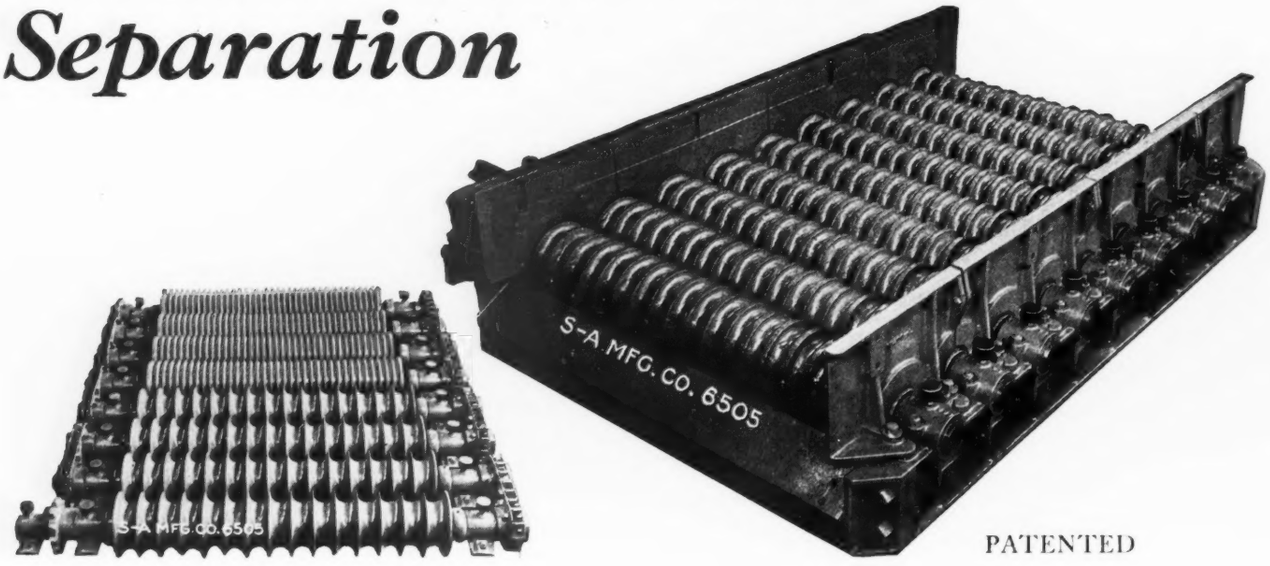
The story of the Homestake mine. Discovered in 1876, this famous property has produced almost $200,000,000 in gold and paid almost $49,000,000 in dividends. It is today second only to the Hollinger in the Western Hemisphere.

Flotation of Rand Pyritic Gold Ores-II

By H. Hardy Smith

The Homestake Gold Mine at the Town of Lead, South Dakota

A "Live Roll" Principle that Gives the Utmost in Separation



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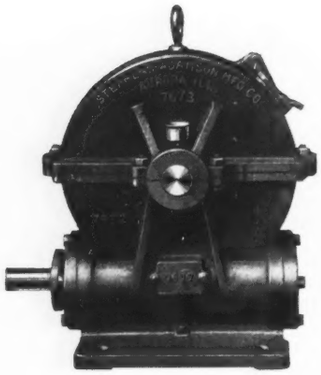

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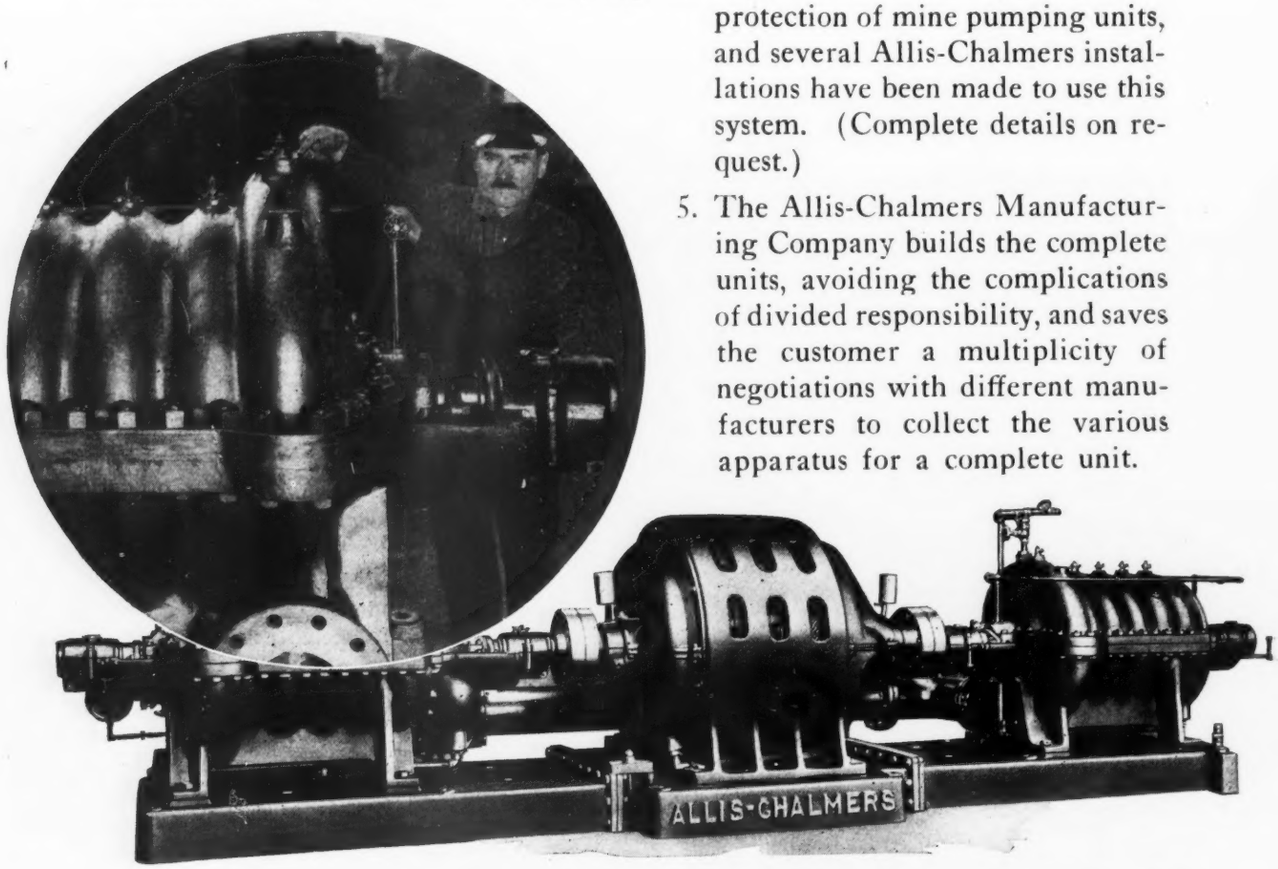

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ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

Volume 122 New York, August 7, 1926 *Number* 6

Half a Century at the Homestake Mine

THERE are frequently individual industrial plants that continue in successful operation fifty years or more, but in the gold industry mines are usually discovered, developed, and exhausted in a few years. Some have a skyrocket or meteoric career of a few years, and then revert to nature. Not so with the Homestake mine, which has a record of fifty years of production under the same corporate name and only four general managers. In this period it has paid dividends at an average rate of one million dollars per year, on an average production of approximately four million dollars per annum. This mine successfully passed through the vicissitudes of frontier life, including Indian uprisings, the day of the ox-team freighter, the Pony Express, the building of the railroads, and today enjoys the advantages of electrical equipment, the latest metallurgical methods, modern libraries and hospitals, and a thriving commercial city. Ore reserves and improved metallurgical processes are such that it has the promise of many years of profitable life. It is, therefore, fitting at this semi-centennial celebration, Aug. 6 and 7, 1926, that the *Engineering and Mining Journal* devote some pages in this issue to the history and progress of this greatest gold mine in the United States.

The St. Lawrence Earthquake

THE ST. LAWRENCE EARTHQUAKE, which affected such a broad area in February of last year, has been studied by the U. S. Geological Survey. The physical results of the earthquake, as of other earthquakes, are well known and easy for the investigator to tabulate; but in earthquakes, as in eclipses or ore deposits, the curious public would like to know the cause, and how to prevent as well as to chronicle. The prediction in the case of eclipses has been absolutely solved by astronomy and mathematics; in the case of ore deposits science is in a transition stage, having made great strides and having great strides yet to make; in the case of earthquakes we are much more in the dark as to causes, and as to what may yet happen.

When the St. Lawrence earthquake occurred, the newspapers were full of interviews with various geologists, each of whom ascribed the earthquake to slipping along a fault, and each mentioning a different fault, some on land and some in the sea bottom where opposing evidence could not be offered. The fault hypothesis —for it was nothing else—sprang from the San Francisco earthquake, which was accompanied by differential movement along a fault plane, a phenomenon which was grasped as explaining the quake. It was, however, evidently as likely that the quake explained the fault, or that both were due to a third undefined cause; and *Engineering and Mining Journal* pointed out editorially the equal weight at least of these hypotheses.

The report of the U. S. Geological Survey bears out this criticism: and finds no connection between the earthquake and any or all faulting; or, as it puts it, not so clearly, "between the severity of the shock and the structure of the rock beds." The report states that the cause of the earthquake is to be traced back to the Glacial Period, some fifty thousand to a hundred thousand years ago. At that period the affected area was under a thick sheet of ice, the weight of which is supposed to have sunk this region beneath the sea. With the melting of the ice the crust is supposed to have been recovering its normal balance—recovering by jerks, the latest of which is represented in this earthquake. Yet the report does not give any evidence of sudden change of level, however slight, accompanying the earthquake; so that one is compelled to classify this explanation, with the fault hypothesis, as a guess, and one not to be embraced seriously. Such an explanation could not apply to recent earthquakes which have affected the Atlantic coast, such as the Charleston earthquake, where the area most affected was far south of the former Glacial area.

Rating of Professors by Students

AT TWO COLLEGES—Iowa City College and Tufts —it is reported that students are asked to fill out questionnaire blanks, giving their opinion of the faculty, the questions covering such points as the clarity of the teacher's expression and the inspiration they get from him. This is a novelty which arouses mixed feeling, and one would need to know more about the working out before being able to give a judicial opinion. To whom do these questionnaires when completed go? Are the faculty members thus analyzed the same body as those who sum up the questionnaires, or are they inspected by a secret committee? Do the students sign their names to such questionnaires, in such a way that each professor gets to know the frank opinion of each of his students? Iowa City and Tufts are small colleges, in which frank opinions would be by way of being personal.

If the opinion is anonymous, it would be without much value, especially as it would give free scope to the joker, a definite figure in student bodies. A large proportion of students would vie in having their opinion humorous, rather than sober. If, on the other hand, the student knows that his opinion of the professor who lectures to him and marks his examination papers, and determines without appeal whether or not he will pass the course, and in which grade; will come under the eye of that professor—then it would be not only a very judicial and brave but a very rash and almost irresponsible student who would tell the naked and unadorned

truth in his questionnaire. How much more of Christian charity—how much more of wisdom—to remember that courtesy and optimism are among the celebrated virtues, and write what will make the professor cheer up a bit under his heavy task and light pay, instead of going to his wife and telling her he's a failure, and he has a great mind to enlist in the marines! Doubtless the better and kinder and safer instincts of the student will prevail: he will write that Professor Driller is thorough, instead of saying that he is prolix, which may mean the same thing to him; he will say that he is cheerful and human, instead of saying that he tired of pulling a laugh at Driller's old gags; and Professor Driller will feel that he has put it over, and that Bill Smoker is not such a dub after all, and has more acumen and understanding than his fat face or his examination papers ever betrayed; and this kindliness will ooze over into Bill's mark, and everybody will feel better. Indeed, to check up this imaginary analysis, it is reported that one of the professors at one of these colleges finds that "The student ratings of the faculty are remarkably intelligent." Intelligence shows itself in many ways. The rating of the faculty by the student is academic; but that of the students by the faculty is remarkably pragmatic.

Facts About the Rand

TWO NEW RECORDS were hung up recently by the gold-mining industry on the Rand—the record for monthly output and that for the daily average. This happened in June, when the mines produced 852,145 oz., or 32,775 oz. per day. This is the reward of improving technical operations in recent years. Better drills, drill steel, and drilling methods are being used. Metallurgy has been improved, and deep development has shown enough ore to warrant work on the maximum scale. The output of gold, which in 1925 was over 50 per cent of the world's total, is likely to be exceeded considerably in 1926. The strike of 1922 which paralyzed the industry, and shut down some of the mines for good, seems very far off indeed. So, although dividends were less in 1925 than in 1924, the stock market looks good for a ride to some. It has been steady thus far this year and of late has shown much activity.

But among the optimists nature has ordained that there shall always be a pessimist or two—in this case the Government Mining Engineer, Sir Robert Kotze. No so good, thinks Sir Robert. Nineteen of the Rand's present productive mines, crushing 6,620,000 tons a year, will be through in five years more. Eleven others, crushing more than 7,000,000 tons per year, have ten years or less to go; and the fourteen producers of the Far East Rand will be exhausted almost as soon. A shrinkage in production will have to be faced within ten or fifteen years, unless new mines are opened or present workings extended, Sir Robert thinks. In some districts, such as the Gogebic Range in Michigan, the life of a mine cannot be predicted safely. But the Rand is a place where ten years means ten years—or not very far away. For thinkers here is food for thought.

Nature has also ordained, it seems, that government shall be by those who are talkers rather than thinkers. This often seems true at Washington and now it is seen in South Africa. There the policy of the present Union, or "Pact," Government toward mining is said to be the reverse of helpful. Through their representatives the unions have inflicted boards of conciliation and government commissions on the operators and have sought various benefits at the operators' expense. Though production is large, costs are high and trending higher, and dividends are less. The gold premium, which in 1924 was almost £4,000,000 for an output of £40,672,447, is no more. Labor is scarce—about 183,000 black "boys" are employed—and tends to be more difficult to get, even with government aid. The burden for industrial compensation is heavy, now being a total of about £5,808,000 per year. It is obvious that if those responsible for the increasing burden of government were thinkers they would have more regard than they appear to have for an industry that last year spent £27,500,000 for salaries, wages, and supplies. The government should consider the economic rather than the political aspect of matters affecting the mining industry, as the retiring president of the Transvaal Chamber of Mines recently said. But this is seemingly a great deal to ask of the government.

Katanga's Labor Problem

DURING THE FIRST SIX MONTHS OF 1926 copper production by the Union Minière in the Kongo was at the rate of 170,000 tons per year. In 1925 actual production totaled 198,500 tons. The rainy season, during which operations are conducted under extreme difficulties and production is unavoidably curtailed, extends from Oct. 1 to April 1, so that the 15 per cent decline in the rate of output must be accounted for by some reason other than seasonal trouble.

The principal cause is shortage of native labor. This was forecast in the annual report, just distributed, in which appears the following statement: "The prospects for 1926 are far from encouraging, and it is to be feared that necessity of maintaining the working operations at all costs may have a detrimental effect on the progress of our new construction work."

The gravity of the situation is indicated by the fact that "working operations" have not been "maintained." That construction has been seriously delayed is certain. Incidentally, new reduction works now in course of erection include a reverberatory furnace plant to produce 30,000 to 40,000 tons of copper annually, a leaching and electrolytic plant to produce 30,000 tons, additional hydro-electric power units to produce 20,000 kw., a flotation plant, and various other auxiliary units. The reverberatories it is hoped will go into commission next year, and the leaching plant in 1928.

Although there are 1,500 Europeans on the company's staff in Africa, they are engaged principally in construction activities, and even there the actual manual labor is performed by natives of the country. A doctrine that never has been disproved is that in any large industrial undertaking the "common" labor must be done by workers indigenous to the locality in which the enterprise is situated. The difficulties attendant upon recruiting and maintaining a working force of 15,000 or 20,000 men in a semi-barbaric region where the inhabitants never have done organized work of any kind scarcely can be imagined by one who has not faced such a problem. For a time it is possible to carry on with men who are induced to work for short terms, but the supply of such men within a reasonable radius gradually will be exhausted unless conditions are made such that a reasonable proportion of them become steady workers. The ultimate solution may be coloniza-

tion: that is, the men and their families must settle down and make homes in the vicinity of the mines and smelters.

Moreover, when large numbers of men are engaged in industrial operations, provision must be made for raising the food crops that are necessary for feeding a concentrated population. Agricultural activities require additional workers; and they must be taught to raise crops, a task that is doubly hard if heretofore they have never done any systematic planting. All this takes time; the process is slow and tedious, as the officials of the Union Minière doubtless are discovering.

Much has been said of the low wages in the African copper country; but the scale of wage is less important if the desired number of men simply cannot be had. That is the situation today in the Kongo. Even if the workers could be obtained at current wages it is doubtful if the labor cost per unit of work done would be low. No definite basis for an estimate exists, but it is likely that one average American worker as a net asset is worth at least ten of the kind of natives that are employed in the Katanga country. Probably they will become less inefficient—less ignorant; but as they do they will learn to obtain higher wages.

One of the important obstacles to rapid expansion of the Belgian Kongo copper operations is the long railway haul for inbound machinery and supplies and outbound copper. But assume for the sake of argument that the mines were only a hundred miles from the seacoast and good ports; assume that the element of transportation were eliminated and that the labor situation was the *only* differing factor; where would be the better place to exploit the astonishingly large and rich deposits of the Union Minière—in the Kongo, where wages are 50c. a day, or in Montana, where they are $5? In which place could copper be produced more cheaply?

Increase of Local Taxes

AS A COMMENTARY on the rapid increase of local taxation it is of interest to note that the total bonded indebtedness of California has now reached the astounding figure of $609,549,227, as of June 30, 1926. During the last fiscal year the bonded indebtedness of that state increased $76,349,976, which represents an increase of 549 per cent over the total bonds issued in 1911. The bonded debt, according to the State Controller, represents 10.5 per cent of the total assessed value of non-operative property.

The debt of municipalities increased at a somewhat slower rate than that of counties. Since 1911 assessed value of non-operative property increased only 160 per cent. The per-capita bonded indebtedness increased from 1912 to 1926, 290 per cent. Bonded indebtedness is increasing at an accelerated rate, for the average increase for the last four years approximates $46,000,000 per year.

Public utilities in California are subject to a state tax of 10 per cent on gross receipts and are therefore not subject to increases in taxation. Bonds are tax exempt. It is therefore evident that private property and private industries must carry the principal load of local taxation. Mining is one of the industries, and especially gold mining, that is hard hit by the increasing tax rates and their complement, increasing assessment valuations. Increasing bonded indebtedness is resulting in a spiraling upward which is adversely affecting private ownership and enterprise. California is not the only state which is mortgaging its future. It is a prevalent disease. A reversal of public policy is critically needed; else private industry will be seriously curtailed.

Automotive Transportation and Mining

AUTOMOBILES were absorbed into the mining industry without a great deal of sales resistance. The engineer and miner were quick to see the advantages of quick transportation, and many mines now maintain a number of machines, and garages and garage service are accepted as essential facilities. Ore transportation over roads required a longer period of development and presents a great variety of mechanical appliances ranging from the steam traction engine, with its train of ore wagons, up to the modern six-wheel truck. Caterpillars were used upon soft road surfaces, but as soon as improved roads became available the auto truck supplanted this useful appliance. Nevertheless, the caterpillar in its modern form is used for transportation where winter snows are deep or roads are poor, and is a useful adjunct for general service about a mine plant. At one important smelting plant tractors of a well-known make are used for hauling charge cars from bins to charging pits where formerly hand-operated "buggies" were used. At another mine auto trucks are in use in open-pit work. Widespread use of the auto trucks has been made in the petroleum industry, the expansion of which would have been slowed down without this useful adjunct.

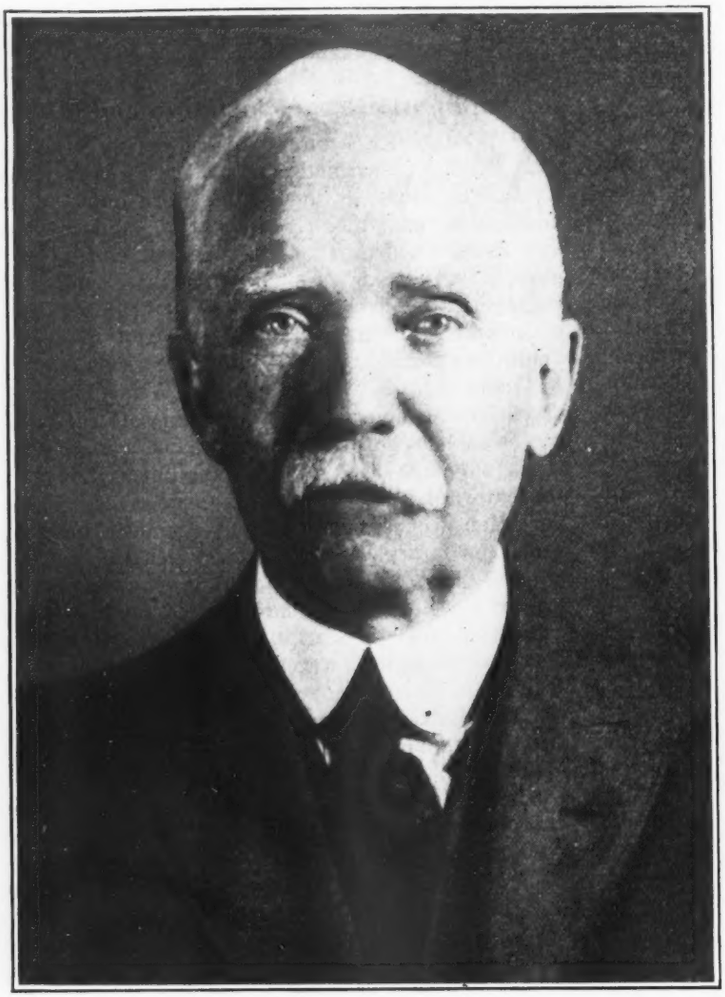
The improvement in design and construction of all automotive vehicles and the wide variety offered by manufacturers of these appliances is such that distance is no longer a critical obstacle to mining operations. Mechanical road-building machinery has made possible the economical construction of roads. Fleets of auto trucks are available for contract work in many localities or they can be readily moved to points where needed.

Miners have their own automobiles with which to go to and from their work. Superintendents and engineers where several mines are operated under one company make their rounds in automobiles. Prospectors and mining men generally utilize this convenient vehicle. Mine supplies are distributed or hauled to isolated prospects by auto.

The mining field offers a small though attractive market to the automotive industry. It is worth studying with the objective in view of more particularly meeting the requirements of the miner and providing sufficient modification of existing standards to meet his needs.

A Diamond Rush

THE SPORTING INSTINCT of the Englishman leads him to stage a foot race whenever government land is to be opened for prospecting and mining purposes. In June the most recent diamond "rush" was held at Elandsputte, in the Transvaal, under government auspices. Ten thousand runners started from a line one and a half miles long when the signal was given by dropping the Union Jack mounted on a bamboo pole. As a preliminary a proclamation was read by the Mining Commissioner. Then the fun began. Fees for permits netted the government £1,750. Happily there were claims for all. Perhaps there will be diamonds, too. If not, the losers will at least have had their sport.



Metallurgists of Note

Herbert Lang

HERBERT LANG was born in Maine in 1854, but has been a resident of the Pacific Coast since 1869. Having set out from his youth to be a member of the mining fraternity, he entered the University of California in 1871, graduating in four years, the first graduate of the College of Chemistry of that institution. The mining course not then having been organized, he gave attention principally to chemical studies, under the tutelage of Professor Rising, finding the laboratory and other facilities most excellent. To supplement these studies he then entered the offices of San Francisco assayers, notably that of Thomas Price, a well-known old-time assayer, and afterward sought engagements in various mining camps, serving as assayer and surveyor, and learning various arts in connection with mining and smelting, to the latter of which he became thoroughly wedded.

During these early years the Comstock was booming, the Panamint region was attracting attention, Bodie had begun to look up, and Eureka was turning out a great quantity of lead-silver bars. Experience was easy to come by, but the technical man, especially if young, was apt to be looked upon askance by the average kind of mining magnate, more accustomed to take the advice and pay for the services of the mining experts of the day who were supposed to be "good judges of a mine," which was as far as their attainments went. No stupendous salaries were in sight, but a youngster could always get a job at wheeling slag pots or feeding the battery, which, by the way, is a good part of any man's mining education.

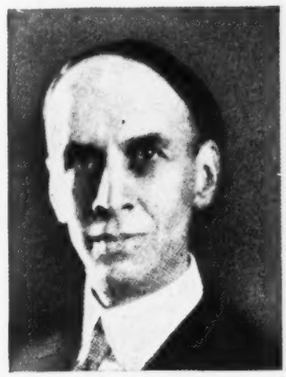
Lang eventually obtained some prestige and set up as a full-fledged mining engineer, opening an office at first in Portland, Ore., the first mining office in the Northwest. Here he practiced his trade, making assays, examining and surveying mines, and building an occasional metallurgical works, until at last he became manager and part owner of a small smelter in Idaho, working on silver-copper ores and shipping matte. At this time some low whisperings about the pyritic process began to be heard, and Lang took hold of the matter and found that there was something in it. Among other things he first demonstrated that copper matte could be concentrated by fusing it with siliceous ores, in a blast furnace, which he inferred from the behavior of the raw sulphides. He became a persistent advocate of this form of smelting, and has written much on the subject, publishing also two books, "Matte Smelting" and "Introduction to Metallurgy." He also invented various improvements in smelting apparatus and methods.

Lang's chief interests now lie in devising methods for the recovery and utilization of waste products of smelters, such as the conservation of the heat of molten slags, the conversion of slag into mineral wool and paint stock, and its formation into building material. The details of much of his work have been published in the technical press, especially in the columns of the *Engineering and Mining Journal-Press*, the *Chemical & Metallurgical Journal*, and other publications. He lives now in Berkeley, Calif., within sight and sound of his old Alma Mater. He married, in 1884, Miss S. A. Simmons, a descendant of an old Cornish mining family.

Half a Century of Mining in the Black Hills

The Story of the Homestake Mine; Discovered in 1876; Company Organized in 1877; Total Production, $199,561,748; Dividends, $48,826,924

By Francis Church Lincoln
Professor of Mining, South Dakota State School of Mines, Rapid City, South Dakota



F. C. Lincoln

HOMESTAKE mine, at Lead, in the Whitewood mining district of the northern Black Hills of South Dakota, will celebrate the fiftieth anniversary of its discovery on Aug. 6 and 7, 1926. The Homestake lode claim was located on April 9, 1876, and the Homestake Mining Co. incorporated Nov. 5, 1877. The company grew rapidly, and the Homestake mine soon came to occupy a prominent position among the world's great mines. At the time of its incorporation, the Homestake Mining Co. owned only two claims, having an aggregate area of about fourteen acres, whereas today it owns 577 patented mining claims and fractions aggregating 3,563 acres. The Homestake claim made its first production during the winter of 1876-1877, when $5,000 in bullion was extracted from a small tonnage of picked ore amalgamated in a crude arrastre. In 1925 the bullion yield of the Homestake Mining Co. was $5,999,073 from 1,589,701 tons of low-grade ore treated in four stamp mills, one ball mill, and three cyanide plants. Up to Jan. 1, 1926, the Homestake Mining Co. had disbursed in dividends $48,826,924, or more than $1,000,000 for each year of its existence. It is the greatest gold producer in the United States. Although its annual gold production is exceeded by mines in Ontario and the Transvaal, yet when due consideration is paid to length of life, persistence in production of low-grade ore, total tonnage mined, total value of bullion recovered, and the amount and regularity of dividends, the Homestake mine stands forth as the premier gold mine of the world.

Gold Discovered Fifty-Two Years Ago

Gold was first discovered in the Black Hills fifty-two years ago. Some believe that gold occurrences were known many years earlier by the Sioux Indians, by the Jesuit priest, Father De Smet, and perhaps by other white men. It is even held that some gold may have been won by white miners prior to this time, as certain evidence suggests; but if such were the case these early miners must have been killed by the Indians.

The Black Hills lay within the Sioux Indian Reservation, closed to the whites by the Sioux Treaty of 1868. When the federal government permitted the Northern Pacific Railroad to be surveyed across this reservation in 1871-1873, the wrath of the Indians was aroused. Fearing serious trouble, General George A. Custer was directed to make a military reconnaissance of the Black Hills in 1874. Custer's expedition was accompanied by two prospectors, William T. McKay and Horatio N. Ross, who discovered placer gold on French Creek, in the southern Black Hills, near the site of the present town of Custer, late in July, 1874.

News of the discovery of gold in the Black Hills spread rapidly, and a stampede was soon in progress toward the new El Dorado. Strict orders were issued from army headquarters to permit no whites to enter the Hills, but several parties of prospectors evaded both soldiers and Indians and made their way into the forbidden land. The largest of these early groups of Argonauts was the Gordon party of twenty-six men, a woman and a boy, which reached French Creek in December, 1874, built a stockade there for protection against the Indians, and succeeded in extracting 70 oz. of gold valued at $20 an ounce before being removed by the military in April, 1875.

Some doubt existed in Washington as to whether there were paying quantities of gold in the Black Hills, so in May, 1875, the geologists W. P. Jenney and Henry Newton were sent into the region under strong military escort to make a more thorough investigation. The Jenney-Newton expedition found gold in numerous localities, but did not penetrate as far to the northward as the Homestake lode. President Grant directed the appointment of a commission to meet the Sioux Indians and negotiate a treaty ceding the Black Hills to the government, but the efforts of this commission were unsuccessful. On June 25, 1876, General Custer and his command were massacred on the Little Big Horn, this tragedy being the indirect result of the discovery of gold by Custer's Black Hills expedition. Not until Sept. 26, 1876, was a treaty signed by the Sioux relinquishing their claims to the Black Hills.

Meanwhile, prospectors had continued to make their way into the Hills, and finding the placers in the vicinity of Custer to be of low value and limited extent, gradually worked their way to the northward until they discovered the rich placers of Deadwood Gulch, where the Homestake property now lies. The first placer claim on Deadwood Gulch was located on Nov. 17, 1875, by Bryant, Coder, and Cudney. When news of this rich strike reached the southern Hills, there ensued an exodus of miners, which left that region deserted.

The first gold quartz found in the northern Hills was the piece picked up by the Bryant party on what is now the Erin claim of the Homestake Mining Co. on the day before the discovery claim on Deadwood Gulch was located.[1] The first lode claims to be located in the Black Hills were the Giant and the Old Abe, which were taken up by J. B. Pearson on Dec. 11, 1875, and now form part of the Homestake holding.[2] The Whitewood mining district was organized in February, 1876.

[1] Anonymous: "Some Black Hills History." *Engineering and Mining Journal*, Vol. 58, 1894, p. 581.
[2] O'Harra, C. C.: "The Mineral Wealth of the Black Hills." South Dakota School of Mines, Bull. 6, 1902; South Dakota Geological Survey, Bull. 3, 1902.

Upper (left)—Moses Manuel, discoverer of Homestake Lode claim. Upper (right)—Samuel McMaster. Lower (left)—T. J. Grier. Lower (right)—Richard Blackstone. Center—Bruce C. Yates. These are, respectively, the first, second, third, and fourth superintendents

Among the many attracted to the Black Hills by newspaper accounts of the discovery of gold by the Custer expedition was Moses Manuel, a seasoned prospector who had just returned from Alaska. He brought with him his brother, Fred, and while making their way from the southern to the northern Hills the Manuels became associated with another prospector named Hank Harney. About the first of April, 1876, this party found some rich float on Gold Run Gulch, south of Deadwood Gulch, at about the center of the present Homestake property. The snow was deep, and they were unable to find the lode at that time, but Moses Manuel returned to the locality every day for about a week, and his perseverance was finally rewarded by finding quartz in place beneath the water in a draw which crossed the lode. This quartz proved very rich. On the following day, April 9, 1876, Moses Manuel persuaded Hank Harney to accompany him to the scene of the strike, where the two located the Homestake lode claim. They sunk their discovery shaft at the side of the draw. The first piece of quartz removed was the richest that ever came from the mine.[3]

GROWTH OF THE PROPERTY HOLDINGS

In the fall of 1877, George Hearst bought the Homestake claim for the Homestake Mining Co., paying

[3]Yates, B. C.: "The Homestake Mine." *Black Hills Engineer*, Vol. 14, 1926, pp. 131-41.

Ox team freighters en route from end of railroad to the Black Hills in the early days

$70,000 for it. The adjoining claim on the west, the Golden Star, was purchased at the same time. These were both narrow claims, the Golden Star having a width of 300 ft. and the Homestake only 150 ft. instead of the 600 ft. allowed a full lode claim. Moreover, since some of the owners did not wish to sell their interests, a compromise was effected whereby they received a strip 150 ft. in width taken from the northern ends of the Homestake and Golden Star and called the Segregated Homestake. Thus at the time of its incorporation the Homestake company owned only two narrow fractional claims having an area of fourteen acres, or about two-thirds of one full lode claim.

The Homestake Mining Co. was incorporated under the laws of California on Nov. 5, 1877, with a capital stock of $10,000,000 divided into 100,000 shares of $100 each. The principal owners were J. B. Haggin, Lloyd Tevis, and George Hearst. Within two years, the company had added to its holdings the larger part of the Nettie claim and the western portion of the Gold Run. Meanwhile, Haggin and Tevis, under the advice of Hearst, secured control by purchase and consolidation of four other groups of claims in the Homestake belt and formed them into separate companies. Thus were incorporated the Golden Terra Mining Co. on Jan. 24, 1878, the Giant and Old Abe Mining Co. on Sept. 25, 1878, and the Deadwood Mining Co. and the Highland Mining Co., both on Oct. 4, 1878. The Highland Mining Co. purchased the Segregated Homestake claim in 1879; and when disputed ground between the Highland and Golden Terra was awarded to the Gopher Mining Co. after a hard-fought legal battle, this property was purchased and divided between the Highland and the Golden Terra. The only other important mines in the Homestake area at that time were those belonging to the Father De Smet Mining Co. and the Caledonia Mining Co. The Clara Mining Co. consolidated with the Caledonia Mining Co. in 1879.

The Deadwood and Golden Terra companies were consolidated in 1880 to form the Deadwood-Terra Mining Co., which afterward took over the property of the Father De Smet Mining Co. By 1883, the Homestake company had increased its capital stock to $12,500,000 and taken over the Giant and Old Abe mine. The Caledonia and Pierce mines were purchased by the Homestake company in 1891. In 1899, the capital stock of the Homestake was increased to $21,000,000 to enable it to absorb the Highland Mining Co., the Black Hills Canal & Water Co., and the Black Hills & Fort Pierre Railway. A further increase in capitalization occurred in 1902, when 8,400 new shares were sold, bringing the capital stock up to $21,840,000. In this same year the Black Hills & Fort Pierre Railway was sold to the Chicago, Burlington & Quincy Railroad, and the Deadwood-Terra Mining Co. was purchased. This completed the consolidation of the big mines on the Homestake belt and brought the Homestake holdings up to some 350 locations, with a total area of 2,624 acres.

Lead, Its Location and Transportation Problem

Lead is situated in the north-central Black Hills of South Dakota at an altitude of one mile above sea level. It is on Gold Run Creek, a tributary of Whitewood Creek, which runs into Deadwood Creek at Deadwood, four miles to the northeast and a thousand feet lower. The Homestake lode passes through the town of Lead; and, indeed, mining operations have resulted in subsidence which has made it necessary to abandon some of the town's structures. Deadwood was formerly the largest town, but as the Homestake interests grew and other mining interests in the northern Hills declined, Lead outstripped its neighbor and in 1920 had a population of 5,013, while Deadwood's inhabitants numbered 2,403.

In 1876 the famous pony express riders began to carry the Deadwood mail; and the following year regular stage-coach service to Deadwood was established. One line of stages ran to Sidney, on the Union Pacific Railroad, 270 miles distant; and other to Bismarck, on the Northern Pacific Railroad, 230 miles away. The trip to Deadwood by stage over either of these lines consumed about fifty hours.

Freight followed the same routes. Heavy freight was drawn by long strings of oxen locally called "bull teams." It was by this primitive but sure method that the Homestake eighty-stamp mill was hauled from Sidney to the mine. The five-ton steam locomotives, the great steam hoists, and all the other heavy mining machinery used upon the Homestake in the early days was hauled into camp by bull teams, which continued to operate over hauls of ever decreasing length with the building of the railroads. Since 1891, with two competing trunk lines at its service, the transportation problems of the Homestake mine have been comparatively simple.

The Homestake company has added materially to its holdings in the Whitewood mining district since 1902, buying the Columbus and Hidden Fortune properties in 1912, and the Oro Hondo mine in 1925. On March 25, 1913, its capital was increased to $25,116,000 by payment of a 15 per cent stock dividend. The company now owns 577 patented mining claims, aggregating 3,563 acres, besides timber and coal lands.

The production of the Homestake company and the companies now consolidated with it to Jan. 1, 1926, was

$199,561,784,[4] or three-quarters the production of the entire State of South Dakota. During the World War, the Homestake mine was also an important producer of tungsten ore, its net sales of wolframite amounting to $630,434. It is now producing tungsten concentrate.

The first and only assessment made by the Homestake company was for $200,000, levied in July, 1878, to pay for the original eighty-stamp mill.

Monthly dividends were paid continuously from January, 1879, to May, 1907, when they were suspended on account of a disastrous mine fire. They were resumed on Jan. 25, 1908; and have continued, with temporary suspensions in 1909-1910 due to labor troubles and in 1919-1921 due to war conditions and a second serious mine fire, down to the present day. Up to Jan. 1, 1926, the sum of $48,826,924 had been paid out in dividends, which is 194 per cent of the present capital and is at an average rate of more than $1,000,000 a year since its incorporation Nov. 5, 1877.

Geology of the Black Hills

The Black Hills uplift is a large irregular dome-shaped anticline. The hills carved from this anticline have a central nucleus of Pre-Cambrian rocks consisting of metamorphosed sediments, amphibolites, and granites. This mass of ancient rocks is surrounded by a wide border of later sedimentaries which dip outward and range in age from Upper Cambrian at the crystalline core to Upper Cretaceous on the outer fringe of the Hills. In the northern part of the Hills, both Pre-Cambrian and later rocks have been invaded by acid intrusions of Tertiary age.

The Homestake ore deposit is near the northern end of the Pre-Cambrian core of the Black Hills. It lies wholly within the metamorphosed Pre-Cambrian sediments (no amphibolites or granites occurring in the mine), at a point where these ancient rocks have been cut by several Tertiary rhyolite dikes and a single phonolite dike, and where the sedimentary cover has been almost completely removed by erosion.

Professor Henry Newton, of the Jenney-Newton expedition of 1875, divided the Pre-Cambrian of the Black Hills into a younger series of slates with strong lithological resemblance to the Huronian, and an older series of schists.[5] These two series were generally accepted by geologists until Van Hise visited the area in 1890 and advanced the opinion that no basis for such a division existed and that the entire Black Hills Pre-Cambrian might be classed as Huronian.[6] Van Hise's conclusions have been confirmed by later investigators, although recently called into question by Wright and Hosted, geologists of the Homestake company, who consider these rocks as of Keewatin age.[7]

Geological investigations were not encouraged in the early days of the Homestake, and the true character of this huge ore deposit remained unknown for a long time. Surface observations led Van Hise to suggest that the ore might fill a synclinal saddle pitching to the southeast. Emmons, Irving, and Jaggar, of the U. S. Geological Survey, were the first geologists to undertake a systematic examination of the deposit, but the Homestake management did not permit them to conclude their investigation. Their work was performed in 1899, but was not published until 1904. They found the Homestake orebody to consist of a series of broad lenticular masses occupying a wide band in the schist with the strike approximately following the schistosity and forming as a long zone pitching to the southeast.[8] To Sidney Paige, who made a reconnaissance of the Homestake mine in 1912, credit is due for the correct interpretation of this structure. Paige showed that the form of the Homestake ore deposit was that of a folded sedimentary series.[9]

In 1920 Sidney Paige again visited the Homestake and spent six weeks with J. O. Hosted and L. B. Wright working out the main features of the folding. Subsequently, Wright and Hosted spent two years in the detailed mapping of twenty-five square miles of surface and sixty-six miles of underground workings.[10] As a result of this work it is known that the Homestake ore deposit was formed by the replacement of an intensely folded and compressed bed of Pre-Cambrian dolomitic limestone. Its major structural features are the great Homestake anticlinorium on the east, followed to the westward by the great Lead synclinorium, with axes pitching about 45 deg. southeasterly. Upon these major features are superimposed many minor synclines and anticlines.

[4] *Black Hills Engineer*, Vol. 14, 1926, p. 143.

[5] "Report on the Geology and Resources of the Black Hills of Dakota." U. S. Geographic and Geological Survey of the Rocky Mountain Region, Washington, 1880.

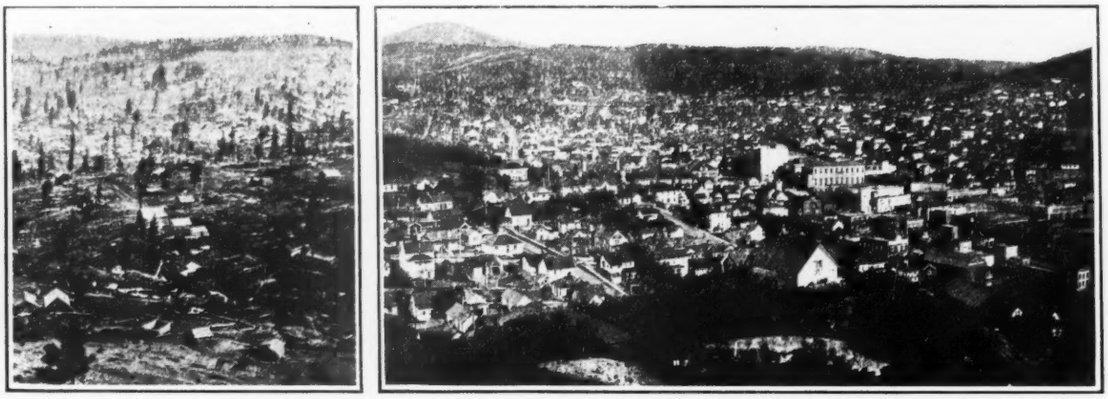
[6] Van Hise, C. R., and Leith, C. K.: "Pre-Cambrian Geology of North America." Bull. 360, U. S. Geological Survey, 1909.

[7] Hosted, J. O., and Wright, L. B.: "Geology of the Homestake Orebodies and the Lead Area of South Dakota," *Engineering and Mining Journal-Press*, Vol. 115, 1923, pp. 793-99, 836-43.

[8] "Economic Resources of the Northern Black Hills." Professional Paper No. 26, U. S. Geological Survey, 1904.

[9] "Pre-Cambrian Structure of the Northern Black Hills, South Dakota, and Its Bearing on the Origin of the Homestake Orebody." Bull. 24, Geological Society of America, 1913, pp. 293-300.

[10] "Geological Methods of the Homestake Mining Co., Lead, South Dakota." *Engineering and Mining Journal*, Vol. 112, 1921, pp. 886-89.



Left—Lead in 1876. Right—Lead, the city, in 1926

The Homestake ore-bearing formation, originally a dolomitic bed with a thickness of 40 to 60 ft., has been drawn out thin along the limbs of the folds and in places pinched out completely. At the crests and troughs it has been compressed and thickened; and in some instances by folding upon itself and repetition it has a thickness up to 400 ft. This complex structure has been further complicated by the injection of an Eocene rhyolite dike, which, following up the steeply dipping schistosity, breaks through the folds at the crest of the Homestake anticlinorium. There is also an intrusion of a later phonolite-porphyry dike which cuts across the Homestake formation and rhyolite dike with a comparatively flat dip.[11]

The Homestake formation varies in composition from a dolomitic to a cummingtonite schist. In the calcareous portions, carbonates in varying proportions occur as calcite, dolomite, ankerite, and siderite. In one instance I noted magnesite.[12] A small amount of cummingtonite is present in the dolomitic phase, which in the cummingtonite phase may increase to nearly 100 per cent. Cummingtonite is a light-brown hornblende occurring in fibrous and radiating masses, which was described by Emmons, Irving, and Jaggar as tremolite, but was shown by the chemical analyses of Sharwood and the optical determination of Prof. G. D. Louderback, of the University of California, to be the iron-magnesium amphibole, cummingtonite.

The principal metallic minerals in the Homestake lode are arsenopyrite, pyrrhotite, and pyrite, which together constitute from 3 to 10 per cent of the ore. Magnetite, hematite, and black oxides of manganese occur less frequently and have been described by W. J. Sharwood, chief chemist of the Homestake company, who has also noted the occurrence of the secondary copper minerals and a unique specimen in which bismuth, telluride, and galena are associated with native gold, fluorite, and calcite in the lining of a vug.[13] Hosted and Wright have added to this list rare occurrences of chalcopyrite and proustite in the ore, and have found psilomelane, pyrolusite, and wolframite in the rhyolite dike.

Native gold occurs in the Homestake lode to the average extent of nearly one-fifth of an ounce to the ton. It is irregularly distributed through the orebodies, and is commonly in such a fine state of division as to be invisible to the naked eye. Occasional large leaves and rarer crystals and arborescent forms have been observed. The gold is always alloyed with silver; the coarser part, which is amalgamable and may be separated from the ore by crushing and panning, has been shown by Sharwood to have a ratio of silver to gold of approximately 1:5. The finer portion removed by cyanidation has a ratio of 1:2.3. Though the gold is frequently associated with the sulphides in the ore, and particularly with the arsenopyrite, it also occurs in association with the non-metallic minerals and in parts of the lode free from sulphides.

Emmons, Irving, and Jaggar believed that the gold was deposited at two distinct periods, Pre-Cambrian and Tertiary. They based this belief upon the fact that though the important orebodies seemed to be associated with the Tertiary intrusives, what appeared to be placer gold occurred in the Cambrian conglomerate overlying the Homestake lode, which indicated that the lode must have contained gold in Pre-Cambrian time to have been eroded to form this fossil placer. This

Mining operations on Deadwood Gulch, in 1876

hypothesis was generally accepted until recently, when Hosted and Wright presented their opinion that the Homestake gold is chiefly, if not wholly, of Tertiary age. They state that the so-called fossil placers are replacements formed in Tertiary time as other deposits in the district are known to have been formed; that all the other gold deposits in the northern Hills are of Tertiary age, and there is no reason to make the Homestake an exception, and that the extent and regularity of decrease in gold values with increase of distance from Tertiary dikes clearly indicates that these dikes were the principal source, even if they were not the only source, of the gold.

Paige holds to the earlier view, and though acknowledging that the "fossil placers" may possibly have been produced entirely by replacement, advances some further facts supporting the hypothesis of two periods of mineralization. Pyrrhotite and magnetite, which are constituents of the Homestake ore, do not occur in the overlying deposits produced by replacement in Tertiary time. Pyrrhotite, pyrite, and gold in the Homestake ore have been deformed by crushing, which apparently took place in Pre-Cambrian time. Seventy per cent of the Homestake gold is amalgamable, whereas none of the gold in the overlying Cambrian dolomite is. The ratio of silver to gold is much lower in the amalgamable Homestake gold than in the Tertiary gold above. Paige suggests that since the proportion of silver to gold in the non-amalgamable Homestake gold is similar to that in the non-amalgamable Tertiary gold of the overlying orebodies, the 30 per cent of gold obtained by cyanidation of Homestake tailings may represent roughly the proportion of Tertiary gold in the Homestake lode. Dis-

[11]Hosted and Wright: *loc. cit.*; Paige, S.: "The Geology of the Homestake Mine," *Economic Geology*, Vol. 18, 1923, pp. 205-237, and "Geology of the Region Around Lead, South Dakota, and Its Bearing on the Homestake Orebody." Bull. 765, U. S. Geological Survey, 1924.

[12]"Certain Natural Associations of Gold." *Economic Geology*, Vol. 6, 1911, pp. 293-95.

[13]Sharwood, W. J.: "Analyses of Some Rocks and Minerals from the Homestake Mine, Lead, South Dakota." *Economic Geology*, Vol. 6, 1911, pp. 727-89.

cussion of the age of the Homestake gold is still under way.[14]

After sinking the Homestake discovery shaft, Moses Manuel and Hank Harney ran an open cut, from which they sent picked ore first to an arrastre and later to stamp mills. When the Homestake company erected its eighty-stamp mill, in the summer of 1878, the tramway level of the mill was extended into the ore and open-cut mining began. The Deadwood mine was also worked by open cut.

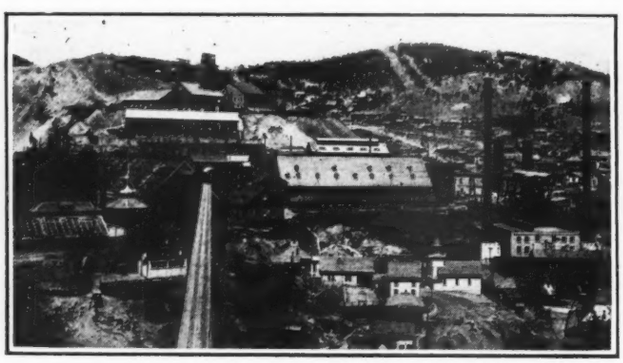
The Homestake next sunk the Star shaft on the incline of the lode and then put down a vertical shaft 400 ft. north of the Star. The latter shaft disclosed ore 240 ft. wide on the 100 ft. level, and stoping was begun upon this body at once. A sill floor was excavated and timbered by the square-set system, using 8 in. by 8 in. square timbers set on 6-ft. centers. The floor was covered with 6-in. lagging and the ore blasted down upon it from the floor above, this procedure being repeated upward until the sill of the stope above was reached. The ground was so heavy that four relief posts were usually placed about the regular posts, and bulkheads of solid timber were also employed, but in spite of all precautions big slabs frequently fell from the back to the sill floor, carrying the timbers with them.

Failure of Early Stopes

The Golden Terra, Highland, and Father De Smet mines were worked from the first by underground mining, and their great stopes all failed, as graphically described by Richard Blackstone, late superintendent of the Homestake company, who says:

> "It is notable that every one of these stopes caved clear down to the sill floor practically without warning. The Father De Smet groaned with its load, and in a night went down in a flat mass of timbers on the sills. The Golden Terra was open towards the gulch and fell with its load like a deadfall. In fact, the compressed air shot two men out through side drifts to their death. The big stopes in the Highland tramway fell with scarcely any warning, the miners barely having time to get into the side drifts for safety."[15]

Shrinkage stoping on the Homestake lode was initiated by the Deadwood-Terra Mining Co. prior to its consolidation with the Homestake. The Deadwood-Terra orebody was from 30 to 50 ft. wide and had a



Homestake plant at Lead

dip of 75 deg. A level was opened by running a crosscut from the shaft and cutting out a sill floor the entire length and breadth of the ore. A drift in the footwall about 20 ft. from the orebody was connected with the stope by crosscuts every 40 ft. which formed shoveling holes through which the excess ore was removed as stoping progressed upward. On account of the greater width of its principal orebody, shrinkage stoping was not introduced in the Homestake mine till much later, and then in combination with square setting.

Prior to 1900 there was no regular system of "stopes and pillars" in the Homestake mine, and it was customary to cut sill floors the full size of the ledge. In that year, W. S. O'Brien, then mine foreman, and B. C. Yates, then mine engineer, divided the ore on the 600-ft. level into stopes extending 60 ft. along the ledge and from wall to wall, alternating with pillars of the same size. The stopes were mined by square setting and filled with waste, after which crowns and pillars were square-set and waste-filled or caved. By 1903, the shrinkage system had been introduced for mining these 60-ft. stopes. Shrinkage stoping was carried to within 20 or 25 ft. of the level above. This stope was then drawn, the sill floor shoveled clean and a mat of timber spread upon it to prevent a run when coming up to the stope from below. Waste filling was run in through raises.[16]

Though the Homestake mining system of today is similar to that of 1903, it has undergone a number of modifications. In 1903, the whole sill floor of each stope was timbered and three lines of track were laid lengthwise of the stope and connected by cross tracks. Later, the amount of timber used on the sill floor was reduced by employing two tracks, one on each side of the stope, and timbering the trackways only. Then the tracks were placed in 8-ft. cuts beneath the pillars on each side of the stope, relieving the trackway timbers but somewhat weakening the pillars. A few years after this the width of the pillars was reduced from 60 ft. to 42 ft. Then the trackways at the side of the stopes were abandoned in favor of 7 x 7-ft. crosscuts driven through the center of each pillar from wall to wall and connected with the stopes on either side by means of shoveling drifts 30 ft. apart. This eliminated timbering from shrinkage stopes but weakened the pillars.[17] Next, shoveling platforms were introduced in the drifts to assist in loading cars. Up to 1917, no ore from the shrinkage stopes was drawn into cars from chutes, because it broke into fragments of too great size to pass through chutes. In that year the practice of blockholing on top of the ore pile immediately after the ore had been shot down was initiated, and chutes were built, making it possible to draw off most of the ore directly into the cars.

The broken ore on the sill floor is removed by shoveling. Until 1923, the sill floor was cleaned last—after the rest of the ore in the stope had been drawn. In that year the practice was introduced of cleaning the sill floor first. The sill floor is now cut out, the back arched in the form which a pile of ore would naturally assume when the chutes had drawn off all the ore that would run, and the sill floor cleaned. Chute lines are next constructed along timbered trackways on both sides of the stope next the pillars, a timber mat is placed on the floor of the stope between them, and the stope filled

[14] Wright, L. B.: "The Relation of Tertiary Rhyolites to Mineralization in the Homestake Mine." *Black Hills Engineer*, Vol. 14, 1926, pp. 163-67.

[15] "The Homestake Mine," *Pahasapa Quarterly*, Vol. 5, 1916, pp. 16-30.

[16] Yates, B. C.: "Some Features of Mining Operations in the Homestake Mine, Lead, South Dakota." Black Hills Mining Men's Association, 1904.

[17] Tyssowski, J.: "Stoping at Homestake Mine of South Dakota." *Engineering and Mining Journal*, Vol. 90, 1910, pp. 74-76.

with waste. Then shrinkage stoping proceeds upward, the excess ore being drawn down over the waste to the chutes, and with the completion of the stope all the remaining ore is withdrawn in this manner. Finally waste fill is run in upon the arch of waste originally placed at the bottom of the stope until the entire excavation is filled.[18]

In 1916, 65 per cent of the ore mined came from shrinkage stopes, 18 per cent from square-set stopes, and 17 per cent from glory holes. In that year a method of mining crushed ore through raises known as "draw holes" first came into prominence, although it had been employed to a slight extent for many years. From 1918 to date, draw-hole mining has been responsible for half the production of the mine. The first draw holes were nine-post, four-compartment, timbered raises with a grizzly at the top upon which large boulders might be blockholed, and a chute at the bottom. One compartment served as a ladderway. No filling having been employed in the early days of mining, a great deal of caving took place above the 500-ft. level, the ore becoming so mixed with waste and timbers that it could not be profitably extracted by square setting. With draw holes brought up beside the caved section and broken through to it, mining the crushed material became very cheap. Waste and ore are sorted by the chute drawer, the ore going to the mill and the waste being used for filling. The more recent draw holes have been constructed by excavating two 6 x 6 ft. raises about 20 ft. apart and connecting them at the top. One of these is untimbered, with grizzly at top and chute at bottom; the other is timbered and divided into a ladderway and timber compartment. When the draw hole is completed, the caved area is opened up by breaking through on the side next the grizzly.

Drilling and Blasting

In the early days of the Homestake, all drilling was done by hand. The work was very arduous on account of the hardness and toughness of the ore and country rock. The first air compressor was installed in 1894. It was an Ingersoll-Sargent duplex steam-driven 500-hp. compressor with a rated capacity of fifty drills operated continuously, or seventy-five drills under ordinary working conditions. In 1901 a high-pressure air compressor for supplying air to compressed-air haulage motors was placed in operation. By 1904 there were, in addition to these two compressors, a 300-hp. duplex, a 1,000 hp. two-stage compound Corliss, and two low-pressure compressors for cyanide mill use in operation. All these compressors were steam-driven, but in 1917 the high-pressure haulage compressor was changed to electric drive. In 1919 three new electrically driven mine compressors were installed, a Nordberg 750-hp. with rope drive and two Ingersoll-Rand direct-connected, each of 800-hp. All the steam-driven compressors were discarded with the exception of a small high-pressure auxiliary haulage compressor. In 1924 a fourth electrically driven mine compressor was placed in service—a 1,080-hp. Ingersoll-Rand. The Homestake company now has in operation four compressors having a combined capacity of 16,268 cu.ft. of free air per minute, supplying air at 100-lb. pressure to rock drills and pneumatic machines. There are also a high-pressure compressor, auxiliary, and reserve, and four low-pressure compressors supplying air to cyanide plants.[19]

In 1904 the Homestake company had in use 244 rock drills ranging in size from 2½-in. drills for blockholing to 3½-in. drills for heavy mining. The drills employed in greatest number were the Ingersoll D-24 3-in. Two of these drills were in use in each of the large stopes, with one or two small drills for blockholing. Electric rock drills were tried in the mine several times, but did not prove satisfactory. Though they used less power per foot of hole than air drills, their rate of drilling was slower, making the labor cost exceed the saving in power, and, besides, they were more expensive, heavier, and required more careful handling.[20] At present stoping is accomplished with 248 drifting machines mounted on columns. For raising, both Ingersoll-Rand CCW-11 and Cleveland 44-SW stopers are employed, and blockholing is performed with Cleveland 44-TW rotators. All drilling is done wet with 1-in. quarter-octagon hollow drill steel. The drill-sharpening shop employs twenty-five men and eleven drill-sharpening machines, and prepares for use 3,000 drill steels daily.

Cyanide plant of the Trojan Mining Co., Trojan, S. D.

All blasting is done with 40 per cent gelatin dynamite in cartridges 1⅛ in. in diameter. For stoping and blockholing triple tape fuse and No. 6 composition caps are used. The fuse is cut in 2- and 3-ft. lengths for ordinary blockholing, in 4-ft. lengths for blockholing in stopes, and in 6-ft. lengths for shooting in stopes. In drifts and shafts, electric firing is employed, No. 6 electric caps, delay caps, and fuse igniters being used.

Haulage and Hoisting

Harney and the Manuels purchased an ox team, which they used to haul ore from the Homestake claim to their arrastre in the winter of 1876-77. When the Homestake company took over the property, ore from the open cut was for a short time hauled to the mill by horses. In 1879, however, tracks were laid and a five-ton Baldwin locomotive was purchased, which took care of the surface haulage. Two more of these small steam locomotives were bought, and steam haulage continued in use till 1901, when a compressed-air system was installed. Each steam locomotive handled a net load of thirty tons; whereas the fourteen-ton compressed-air locomotive which replaced the steam locomo-

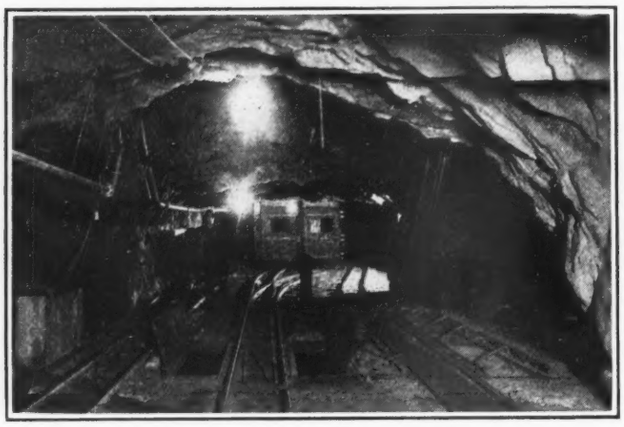
[18]Ross, A. J. M., and Wayland, R. G.: "Mining Methods at the Homestake." *Trans.*, A.I.M.E., Vol. 72, 1925, pp. 424-45; and "A Brief Outline of Homestake Mining Methods." *Black Hills Engineer*, Vol. 14, 1926, pp. 145-156.

[19]Staple, S. J., and Mackie, H. A.: "The Mechanical Department of the Homestake Mining Co." *Black Hills Engineer*, Vol. 14, 1926, pp. 202-25.

[20]Wiggert, J. F.: "Development of the Homestake Electrical System." *Black Hills Engineer*, Vol. 14, 1926, pp. 182-202.

tives hauls thirty-two 4-ton cars, or 128 tons net. Two 7½-ton compressed-air locomotives have been added to the surface haulage equipment. These locomotives are charged with air at 1,000-lb. pressure and operate on tracks of 22-in. gage.

When the Homestake mine was first opened in depth by the Star and Vertical shafts, the ore was close to the shafts and was trammed by hand to the stations. Later, horses and mules were introduced. Compressed air proved so satisfactory for surface haulage that in 1904 a 5-ton compressed-air locomotive was ordered for



Top of underground crushing plant in Homestake mine

underground use. The trial locomotive proving a success, in 1905 an Ingersoll-Rand high-pressure air compressor with a capacity of 1,800 cu.ft. of free air per minute was installed and compressed-air locomotives were purchased to replace the ninety horses and mules. At present the company has twenty 5-ton and ten 3-ton compressed-air locomotives in underground service. They are charged with air at 1,000-lb. pressure and run on tracks of 18-in. gage. The maximum load hauled by an underground locomotive is forty-five 1-ton cars.

Three hoisting shafts are now in service, the Ellison, the B. & M. or Old Abe, and the Old Brig. Use of the Old Brig shaft will soon be discontinued. It is equipped with a geared electric hoist. A large amount of ore is now being hoisted through the B. & M. shaft, but this will probably have to be abandoned soon, as it is in ground which is likely to cave. The B. & M. No. 2 shaft is being made ready to put into commission to take the place of the B. & M. Steam was formerly used for all hoisting, and is still employed at the B. & M. shaft. At the Ellison shaft steam is used for the man hoist only. The man hoists at both B. & M. and Ellison shafts were originally used for hoisting ore and were each equipped with two balanced double-decked cages and flat ropes. In each case, one of the cages has been replaced by a counterweight, and these old hoists are now employed for men and materials only. The B. & M. skip hoist is a Nordberg, compound, condensing, Corliss steam hoist operating two 6-ton skips in counterbalance from loading stations on the 800-, 1,100- and 1,550-ft. levels to crusher bin at the surface.

In 1921 an electric skip hoist and crushing system was put into operation at the Ellison shaft. It has two drums, each 10-ft. in diameter with 7-ft. 2-in. face, connected to shaft operated by a 1,400 hp. motor by friction clutches. This hoist with 7-ton skip, has a capacity of 4,000 tons in fifteen hours (two shifts) from the 2,230-ft. loading pocket (the lowest pocket in the mine). Though the main use of this hoist is in raising ore, a skip-changing device has been installed at the bottom of the shaft, which makes it possible to change quickly from skips to double-decked cages, which greatly expedite the handling of men going on and off shift. Primary crushing to 4½ in. is conducted underground at the Ellison shaft and secondary crushing to 2 in. at the surface. On the 800-, 1,400-, and 2,000-ft. levels are located 36 x 48-in. jaw crushers driven by 125-hp., 2,200-volt motors. Below each crusher is a 1,500-ton ore bin and below that a skip loader operated by compressed air.

PUMPING AND DRAINAGE

A Cornish pump with a capacity of 275 gal. per minute was installed at the B. & M. shaft in 1879. Its engine was at the surface with a steam cylinder 26-in. in diameter and a piston with a 60-in. stroke. The pump rod was constructed of 12 x 12-in. timbers and extended from the surface to the 800-ft. level, its weight being counterbalanced by rocking counterweights. Attached to this pump rod were single-acting vertical plunger pumps, which raised the water to the surface from the 800-ft. level in three stages. This Cornish pump was superseded in 1902 by a Riedler compound condensing steam pump of 550 gal. per minute capacity under 1,200-ft. head. This pump was installed on the 1,100-ft. level near the Star shaft and raised water to the surface in a single lift. With occasional assistance from the Cornish pump, the Riedler pump handled all the water of the mine up to 1913, when electric pumps were installed and the old steam pumps dismantled.

The electric pumps were three-stage centrifugal, 125 hp., Jeanesville pumps each having a capacity of 1,000 gal. per minute under 325-ft. head. They were installed in pairs at the B. & M. shaft at 300-ft. vertical intervals from the 500- to the 1,400-ft. level. Water was formerly pumped from the 200-ft. level to the surface, but now runs from that level through an adit by gravity. The normal mine flow is only 400 gal. per minute, so one of each pair of pumps is held in reserve. Pumping from the lower levels is performed at the Ellison shaft, where similar pumps are placed at the 2,300-, 2,000-, and 1,700-ft. levels pumping the water to the 1,400-ft. level, where it runs by gravity to the B. & M. pumps.

VENTILATION

During the early life of the mine, natural circulation of air was depended upon entirely to secure ventilation, and improvement in ventilation was only accomplished by making new connections between mine workings. Later, small motor-driven fans were placed in the mine and filled all needs up to recent years. A regular system of forced ventilation finally became necessary, and in 1923, a large ventilating fan was placed on the surface at the top of an inclined air shaft. This is a 300-hp. reversible electric fan with a capacity of 225,000 cu.ft. of air per minute against 4½-in. water gage. It is run as an exhaust fan, and with two auxiliary 60,000-cu.ft. fans, one on the 1,400-ft. level of the B. & M. shaft and the other on the 1,800-ft. level of the Ellison shaft, supplies the main workings with an abundance of fresh air. Small fans continue to be used when necessary for the ventilation of isolated parts of the mine.

The first mill to treat Homestake ore was the arrastre built by the Manuel brothers and Hank Harney on Whitewood Creek in 1876 and operated by water power. In 1877, Moses Manuel put up a ten-stamp mill, in which he treated ore from the Homestake claim. He also sent some ore from the claim to other small custom mills. These custom mills became numerous and did a thriving business on the basis of an $8-a-ton milling charge until driven out by the construction of company mills.

The first company mill to operate on Homestake ores was the mill erected by the Homestake No. 2 company and acquired by the Highland Mining Co. early in 1878. In 1880 the Highland 120-stamp mill was put in operation, and the old mill abandoned. The Highland 120-stamp mill now constitutes part of the Homestake company's Amicus mill.[a]

The next company mill to be placed in operation, and the first mill of the Homestake company, was the Homestake 80-stamp mill, which began dropping its stamps on July 12, 1878. This was the mill for which the Homestake company made its first and only assessment. It was afterward increased in size to a 220-stamp mill, and continued in operation until 1922. By that time it had become undermined, so it was wrecked and replaced by the new South mill of 120 heavy stamps, which is the latest mill of the Homestake Mining Co.

The Father De Smet 80-stamp mill was also erected in 1878; the Golden Star 120-stamp mill of the Homestake company and the 60-stamp mills of the Deadwood and the Caledonia companies were built in 1879. In 1880, besides the Highland 120-stamp mill already noted, the Golden Terra put up a 60-stamp mill. Thus in two years the number of stamps dropping in company mills increased from 30 to 580. In 1891 the Deadwood mill was abandoned and the Terra increased to 160 stamps. In 1904, the Homestake company had 1,000 stamps, divided among the various mills as follows: Amicus, 240; Homestake, 200; Golden Star, 200; Deadwood-Terra, 160; Caledonia, 100; and Monroe or Father De Smet, 100. In 1913, the Homestake was operating 1,020 stamps with a daily capacity of 4,284 tons. The Terraville 250-ton ball mill was put in operation in 1920.

The crushing mills at present in operation on gold ore are the South mill with 120 heavy stamps, the Amicus 240-stamp mill, the Pocahontas 160-stamp mill, and the Terraville ball mill, with an aggregate capacity of 4,500 tons daily. There is also a light 5-stamp mill at work on tungsten ore.

Changes in stamp-mill practice may be noted by comparing the Homestake mill of 1878 with the South mill of today. Homestake stamps weighed 800 lb. each. South mill stamps weigh 1,550 lb. The Homestake mill crushed about two tons per stamp per day during its first year, which was regarded as good work. The South mill now crushes 1,800 tons per day, or 15 tons per stamp. Gold was caught on copper amalgamating plates both inside and outside the batteries in the Homestake mill, whereas in the South mill the plates are all outside and are silver plated. The ore is crushed to the proper size for the South mill stamps in and at the Ellison shaft, whereas the Homestake mill made this reduction with a Blake crusher placed below a grizzly at the top of the mill. Six rod mills assist the stamps in grinding the South mill ore for amalgamation, whereas the Homestake mill crushed with stamps only. Power for the Homestake came from steam raised by burning cordwood; the South mill is operated entirely by electricity, the greater part of which has a hydroelectric source. Tailings from the Homestake mill originally ran down the creek bed carrying away 30 per cent of the values in the ore, but tailings from the South mill are treated in cyanide plants, with a final loss of about 5 per cent.

Attempts to save the values in the tailings by concentration began in 1882, when a blanket house was erected and tables covered with Brussels carpet were installed. Blanket tables continued in use up to 1891, the concentrates made upon them accumulating and eventually being sold to the Deadwood & Delaware smelter and the Pluma chlorination works. Perfection bumping tables were next tried, but did not meet with success. Two millmen set up four Harz jigs below the Lead mills and began shipping concentrates on their own account, whereupon the Homestake company erected a jig house in 1895, installing twelve Harz jigs in it and later added Evans slime tables and a buddle. This concentrator shipped about 50 tons of concentrate a day assaying from $6 to $8 a ton and continued in operation until the erection of the first cyanide plant.

Charles W. Merrill began to experiment with the treatment of the Homestake tailings by cyanidation in 1898. In 1899, a 60-ton experimental plant was built to treat sands from the Amicus mill and was operated for two summers, demonstrating the feasibility of the method. A 1,300-ton sand plant began continuous operation in April, 1901; and a second sand plant with a capacity of 700 tons per day was placed in commission the following year. The combined amalgamation and cyanidation recovery was 88 per cent. Merrill continued his experiments, and finally in 1906 a slime plant treating slimes from both sand plants began to operate at Deadwood. A regrinding plant was built in 1908 and enlarged in 1914, which brought the total recovery from the Homestake mills up to 94 per cent.

MANAGEMENT AND MEN

The managers of the Homestake mine have been chosen with care and have attained results fully justifying their selection. From the very first they have been confronted with the problem of mining and milling a low-grade ore with so slight a margin of profit that an error of judgment might easily lead to disaster. Careful consideration and preliminary testing have preceded the introduction of all innovations, and relations between the management and the men have been kept upon the friendliest of terms, with the result that the operations of the company have met with remarkable success. The men who financed the Homestake gave their superintendents free hands, and their superintendents have made the property in some respects the greatest gold mine in the world.

Samuel McMaster, who had mined in Australia and California, was placed in charge of the Homestake mine in 1877 and continued active until just before his death, which occurred in 1884. Then Thomas J. Grier, who had been bookkeeper and secretary under McMaster, was made superintendent and filled the position most ably till his death, thirty years later. He was succeeded by Richard Blackstone, a competent engineer,

[a]Clark, A. J.: "A Review of Homestake Metallurgy." *Black Hills Engineer*, Vol. 14, 1926, pp. 157-62.

[a]Pyle, K. D.: "The Homestake Tungsten Mill." *Black Hills Engineer*, Vol. 14, 1926, pp. 171-74.

who served until the close of 1917. Blackstone was followed by another able engineer, Bruce C. Yates, the present superintendent, who had entered the employ of the company as a mine surveyor many years before.

The number of men upon the Homestake payroll increased rapidly with the growth of the company, reaching a peak of 3,000 in 1906, after which it decreased to 1,600 in 1918, at about which number it has remained to date. In 1891, two-thirds of the men employed did not even understand the English language. In 1924, three-quarters of the employees belonged to English-speaking races, the remaining quarter being Scandinavian, Austrian, and Italian. Men were hired by the foremen and bosses up to 1904, when the Homestake Employment Department began operations, first hiring the mine labor and later all company employees.[23]

In the early days of the mine, the usual shift was ten hours for miners and twelve hours for millmen. In 1906, the Homestake company placed its entire force of more than 2,000 on the eight-hour basis, at the same wages previously paid for the longer twelve-hour day. The only labor controversy in which the Homestake management ever became involved occurred in the winter of 1909-1910, when the Western Federation of Miners attempted to unionize the camp. The mine shut down on Nov. 24, 1909, to avoid a strike; and reopened on Jan. 10, 1910, on a non-union basis. Within forty-five days after resuming operations the property was running at full capacity. As a result of conditions arising from the World War, the mine suffered from labor shortage from 1917 to 1921, although a voluntary increase in wages of 10 to 16 per cent was made in 1917. By 1922, labor conditions had again become normal.

[23]Irwin, E. F.: "Homestake Mine Example in Industrial Co-operation." *Mining Congress Journal*, Vol. 10, 1924, pp. 79-80.

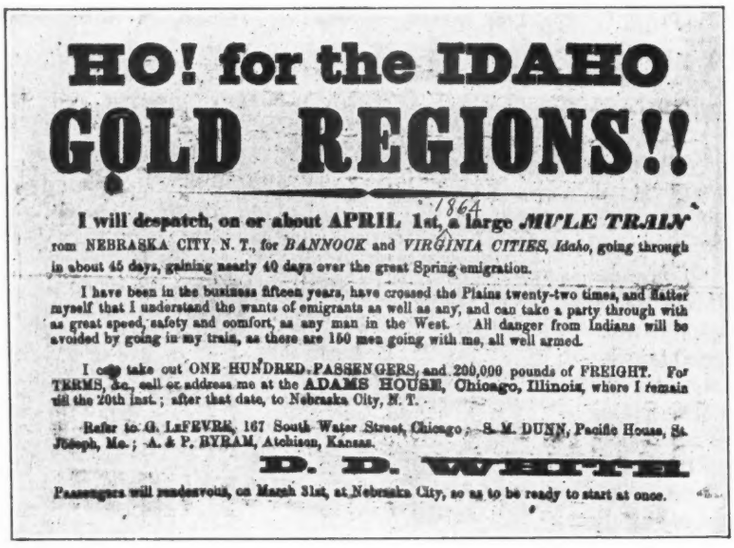
The Homestake Medical Department was instituted in 1879, when the first hospital fund was collected. Since 1906 the hospital has been operated wholly as a company institution, furnishing hospital service free to employees and their families. The Homestake Aid Fund was established in 1910. At the outset, the men each contributed $1 a month and the company $1,000 a month, from which benefits were paid for both accident and sickness. When the South Dakota Workmen's Compensation Law went into effect in 1917, making it obligatory upon the company to pay all compensations for accidents, the company ceased making payments into the fund and it is now used for the payment of sick benefits only.

A safety engineer and assistant safety engineer are employed by the company. They collaborate with a central safety committee, which holds regular monthly meetings, and a workmen's committee, which holds a joint meeting with the central committee every other month. The assistant safety engineer also gives first-aid and mine rescue training.[24]

The Hearst Free Library was presented to the Homestake employees by the late Phoebe A. Hearst in 1894, and moved to its present quarters in the Recreation Building in 1914. The Hearst Free Kindergarten, established in 1900, is now run in conjunction with the library. The Homestake Recreation Building was built under the direction of Superintendent Grier at a cost of $250,000 and opened on Aug. 31, 1914. It contains a swimming pool, gymnasium, rest room, bowling alleys, pool and billiard room, and a theater, in addition to the library. This building is free to employees and public alike and forms the recreation center of the town of Lead.

[24]Brooks, C. A.: "Accident Prevention at the Homestake Mine." *Explosives Engineer*, Vol. 4, 1926, pp. 209-12.

Mule-train service; speed and protection from Indians guaranteed



HO! for the IDAHO
GOLD REGIONS!!

I will despatch, on or about APRIL 1st, 1864, a large *MULE TRAIN* from NEBRASKA CITY, N. T., for *BANNOCK* and *VIRGINIA CITIES, Idaho*, going through in about 45 days, gaining nearly 40 days over the great Spring emigration.

I have been in the business fifteen years, have crossed the Plains twenty-two times, and flatter myself that I understand the wants of emigrants as well as any, and can take a party through with as great speed, safety and comfort, as any man in the West. All danger from Indians will be avoided by going in my train, as there are 150 men going with me, all well armed.

I can take out ONE HUNDRED PASSENGERS, and 200,000 pounds of FREIGHT. For TERMS, &c., call or address me at the ADAMS HOUSE, Chicago, Illinois, where I remain till the 20th inst.; after that date, to Nebraska City, N. T.

Refer to G. LeFEVRE, 167 South Water Street, Chicago; S. M. DUNN, Pacific House, St. Joseph, Mo.; A. & P. BYRAM, Atchison, Kansas.

D. D. WHITE.

Passengers will rendezvous, on March 31st, at Nebraska City, so as to be ready to start at once.

SIXTY-TWO YEARS AGO the would-be Idaho prospector had something to worry about besides finding ore, as the accompanying poster shows. Bannock and Virginia Cities were presumably in the southeastern part of the state. We are indebted to the *New York Central Lines Magazine* for the use of this reproduction.

Flotation of Rand Pyritic Gold Ores—II

Conditions Not Favorable to the Best Work in Full-Size Test Plant—Cascade Type of Machine a Success—Opportunities for Future Promising, Though High Extractions Are Now Obtained by Older Methods

By H. Hardy Smith
Metallurgical Engineer, Tokio, Japan

AFTER IT HAD BEEN DECIDED to advocate the application of flotation to Rand metallurgy by floating the pyrite in the sand, before cyanidation, as mentioned at the end of the previous article in the July 31, 1926, issue, the management of a well-known property on the Far East Rand was approached, as the layout of the mill there permitted a full-scale trial plant to be erected at a minimum of expense and without interfering with current operations. From the point of view of the most suitable sand on which to operate, the choice of this plant was ill-advised, because the ruling high standard of work left only a small margin in which to attempt to increase the profits by improving the recovery. The flow sheet finally decided upon, after laboratory tests, is shown in Fig. 1.

To bring the initial cost of the plant to a minimum it was resolved to dispense with a separate cyanidation unit for the flotation concentrates and to treat them, after regrinding in a special tube-mill circuit, along with the current slime from the mill. This scheme made it impossible to determine the actual extra extraction resulting from the use of flotation, but the reduction in gold content of the sand residue, which was the crucial point, could be ascertained, and if it proved to be satisfactory, means for obtaining maximum recovery of gold from the flotation concentrate were to be provided.

Reference to Fig. 1 will make the scheme of treatment clear, and the type of flotation machine employed is shown in Fig. 2. The underflow from the de-sliming cones, amounting to 600 to 700 tons of sand per twenty-four hours, containing about 30 per cent moisture, was pulped with circuit water to bring the dilution to 1 : 1, and passed by underflow feed pipe into the bottom of the first of a series of two mixing boxes. Crude city gas tar at the rate of about 1 lb. per ton was added at the feed intake and was thoroughly incorporated with the pulp in its passage through the mixers. These required about 10 hp. each with the 24-in. impellers running at a peripheral speed of 1,250 ft. per minute. The underflow feed arrangement shown in Fig. 2 was designed by me to avoid sinking the whole of the plant, including the Dorr thickener and tube mill, an extra 4 ft. below ground level. It worked quite satisfactorily and kept the feed launder clear under all conditions of load. More circuit water was added to the pulp, leaving the last mixer to bring the dilution to 2 : 1, and this pulp was passed by an underflow feed pipe, into the bottom of the first of the eight subaëration flotation cells.

The flotation machine, with eight 18-in. impellers running at 1,500 peripheral feet per minute, took 55 hp., which is considerably above the power consumption of a similar machine when treating ordinary pulp containing the natural proportion of slime. The impellers in the subaëration machine had a life of from ten to twelve weeks. The double impellers in the mixers had a life of eight weeks for the bottom ones and twelve weeks for the top. The ¾-in. cast-iron liners in all the cells had a life of about six months for the bottoms and nine months for the sides. Air was supplied to the subaërator cells at about 3 lb. per square inch, by a No. 7 Alldays & Onions Empire blower, which, at 160

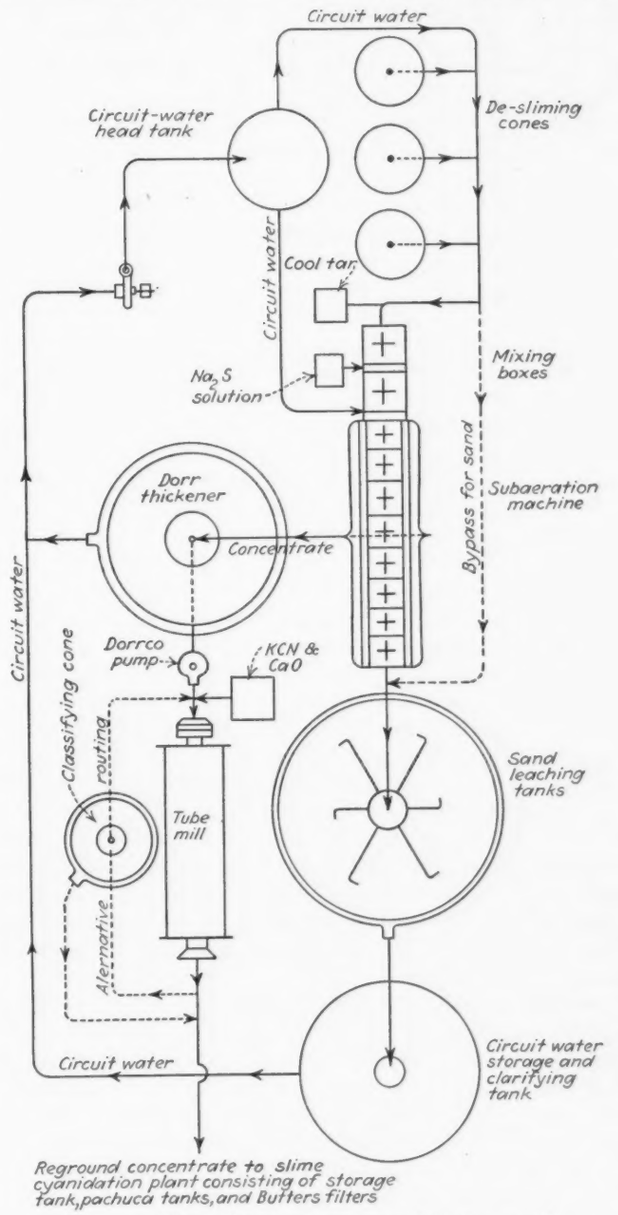


Fig. 1—Flow sheet of commercial size sand flotation plant

r.p.m. delivered 160 cu.ft. per minute, which was ample air for the requirements.

The subaërator was designed to have a volume sufficient to allow three minutes' frothing treatment for

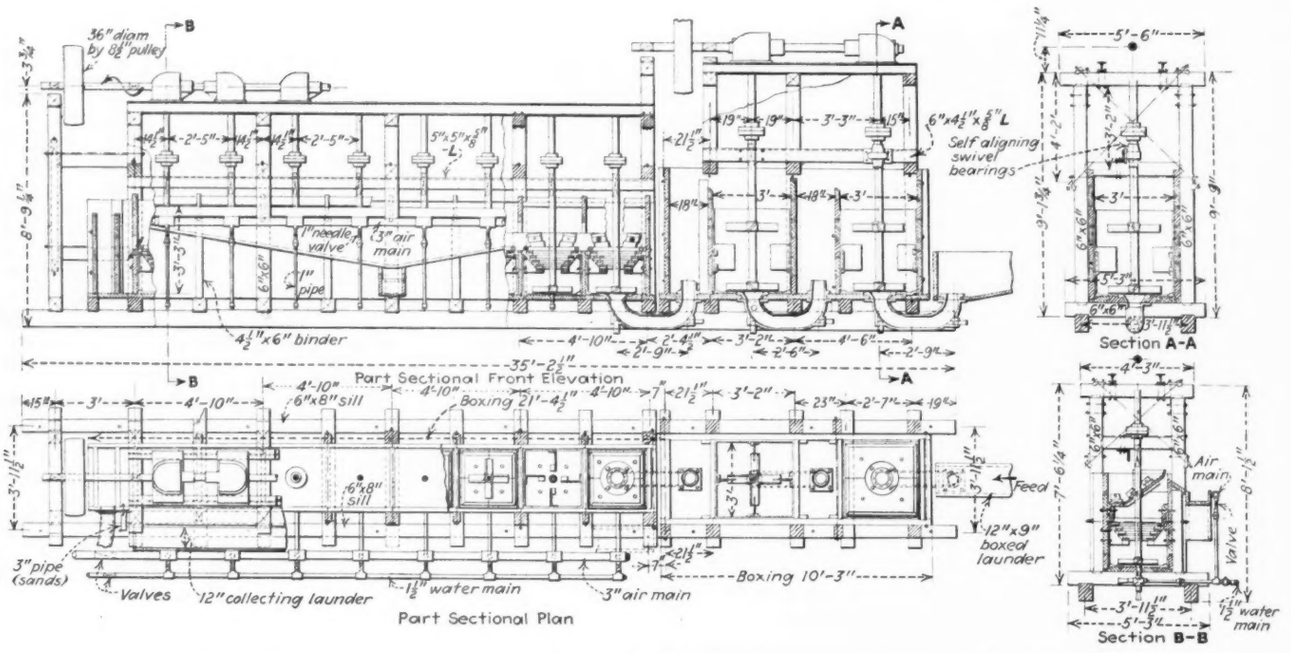


Fig. 2—Design of subaëration sand-flotation machine, with two pre-agitation and eight frothing boxes

the pulp when 600 tons of sand were being handled at 2 : 1 dilution; but as it was soon found that longer time was required the frothing capacity and volume of the machine were increased by altering the "crowding boards" so as to allow the froth to overflow on both sides of the machine, and by displacing the step grids by a simple ⅜-in. mild-steel plate, perforated with 1½-in. staggered holes, 2¼-in. centers, and fitted underneath with four baffles, 4 in. deep, running from center to corners of the cells. After these alterations, the froth area was 14 sq.ft.; length of overflow lip, 32 ft.; and time of treatment 3¼ minutes. The tailing discharged from the machine through a 1½-in. spigot and an overflow weir which could be adjusted to give the correct pulp level in the frothing cells; it ran direct to the cyanide leaching tanks, which were filled by Butters distributors. During the filling operation the overflow from the leaching tanks ran to the circuit-water storage tank, from which the water supply for the flotation plant was drawn. This water was therefore in a closed circuit and soon acquired excellent frothing properties. As 30 per cent of moisture entered the circuit with the original sand, and only about 10 per cent was left in the sand in the leaching tanks, an excess of circuit water accumulated, which was discarded at intervals.

The froth from the flotation machine ran to a 25-ft. Dorr thickener, where it was broken down inside of an annular baffle by water sprays. Settled concentrate was drawn off by a diaphragm pump and discharged into the re-grinding tube mill, where lime and strong cyanide solution were added. Clear overflow from the Dorr thickener joined the circuit-water system.

The tube mill for grinding the concentrates was 4 ft. in diameter by 20 ft. long, fitted with smooth 2-in. cast-iron liners, and partly filled with 2-in. cast-iron balls. It was run at the slow speed of 20 r.p.m. so as to get maximum attrition effect. This tube mill was operated for a period in closed circuit with a classifying cone, but this proved unsatisfactory, so for most of the time the tube mill ran on open circuit. Operated thus, it was capable of reducing twenty-five tons of concentrates per twenty-four hours to 6 per cent plus-200 mesh provided it was fed with pulp containing not more than 30 per cent moisture. Wear on balls and liners was fairly heavy, but the comminuted iron did not appear to affect subsequent cyanidation. With this method of operating the tube mill the tonnage handled and the fineness of product were not up to requirements, and had the plant continued to operate a special classifier of my design, in closed circuit with the tube mill, would have been used. The pulp, after leaving the tube mill, was further diluted with stock cyanide solution, and pumped into the storage tank at the slimes cyanidation plant. Here, the strength of solution used was 0.045 per cent KCN and the time of treatment from thirty-six to forty-eight hours from the time the slime entered the storage tank until it was discharged from the Butters filter. This method of dealing with the concentrates was only a temporary expedient.

The settled slime from the mill, after decantation of the clear water in the collecting tanks, contained about 33 per cent moisture, which entered the cyanide circuit and diluted the solution. About 500 tons of weak, barren solution had to be run to waste with the slime residues each twenty-four hours to make room for the water which entered the cyanide plant with the slime, sand, and concentrate. This point should be kept in mind later on when the precipitation trouble attending the use of flotation is discussed.

Difficulties with Trial Plant

On starting up the flotation plant, difficulties, both metallurgical and mechanical, were encountered. As the former were the most vital they will be covered first.

When the plant was operated as described, the extraction of pyrite was poor, and experiments in a laboratory machine showed that the residual pyrite could not be floated under the conditions ruling in the plant. This fact was indicated in preliminary experiments, but was ignored, so the first flotation plant erected on the Rand had an inauspicious beginning. Belated laboratory ex-

periments soon established the fact that sodium sulphide was a corrective of the inhibitory factor—the small amount of $\frac{1}{8}$ lb. per ton being sufficient to put the pulp in condition for satisfactory flotation of the pyrite. The cause of the trouble lay in the mill water, which entered the plant with the original sand. If a sample of sand from the de-sliming cones were drained on a piece of sacking, flotation of the pyrite could be effected without any sodium sulphide, and if the sand were slightly air dried as well as drained the results were excellent. The deleterious effect of the mill water was at first ascribed to the presence of cyanide. Free cyanide could not be detected in the mill water while the trouble was at its height, but traces of cyanide decomposition products were present. However, the cyanide theory was discredited by the fact that good results could be obtained on sand residues which contained 0.006 per cent of free cyanide as well as some decomposition products.

Effect of Lime in Mill Water

Another chemical present in the mill water in appreciable amounts was calcium hydrate, derived from the lime added to the ore in the bins to give protective alkalinity and aid in the settlement of the slime in the collecting tanks. The inhibitory effect of lime on the flotation of pyrite is well known, and is made use of in preferential flotation. By a long series of tests it was fairly well established that the lime added in the mill bins was at the root of the trouble in the flotation plant, and the small amount of sodium sulphide used was probably beneficial because of its power to correct the action of the lime in the pulp by converting its deleterious portion into harmless soluble sulphur compounds. From a mechanical point of view the presence of dissolved lime in the pulp up to 0.01 per cent CaO was beneficial, as it produced a dense, mobile froth which was easy to handle. When the lime content fell to 0.005 per cent, the froth was a thin, rich scum which was difficult to get off the machine.

Undissolved lime was found to be most detrimental. A pint of spent milk-of-lime added to the head of the machine would entirely upset the flotation conditions, giving a tough, bulky, practically barren froth, which would persist so long as the contaminated pulp remained in the machine. Undissolved lime in small lumps occasionally showed in the sand flowing from the de-sliming cones, presumably having escaped comminution in the tube mills by overflowing the Caldecott classifying cones. At such times the results were poor and the froth was so tough that it was difficult to break it down in the Dorr thickener.

Precipitation Troubles

After the flotation plant had been in operation about three months the gold content of the tailing solutions from the zinc precipitation boxes began to rise. The normal gold content of the barren solution for some time previously had been 0.02 dwt. per ton—good evidence of the excellence of the precipitation practice. Six months after starting the flotation plant the solutions reached the high figure of 0.15 dwt. per ton. In view of the large amount of barren solution which had to be discarded each day, this rise was serious, and the flotation plant had to be shut down to allow the solutions to get back to normal. After a week the assays had fallen to 0.05 dwt. per ton. It was thought that the sodium sulphide might be responsible for the trouble, but this theory was disproved by running for a period without sodium sulphide, when the tailing went up as before.

That the tar was at the bottom of the trouble was most probable, this theory being supported by the appearance of a deposit of a viscous, gummy substance around the edges of the distributor ahead of the precipitation boxes and also in the first compartments of the boxes themselves. As this substance adhered tenaciously to the iron boxes, it could be expected to coat the zinc shavings and thereby cause a decrease in the precipitation efficiency. The truth of this theory was indicated by the increase in the amount of precipitate that had to be smelted and by the fact that the loss in the tailing solution from an extractor box was decreased by filling an extra compartment with fresh zinc shavings.

The reason the trouble took so long to become acute probably was because the cyanide solution could hold a certain amount of the tar derivative in solution, in which state it was not harmful, but once the point of saturation had been reached the least change in chemical or physical condition caused it to separate out. In a free state it is not likely that it could pass the clarifiers; hence an obvious way of overcoming the trouble was to improve, ahead of the clarifiers, the physical conditions affecting precipitation.

Neither of the two metallurgical difficulties enumerated would have occurred in a plant treating sand residues. In an "all-flotation" plant the trouble with lime would not have arisen and the difficulty with precipitation would not have been serious, because only a small amount of solution would have been handled and little barren solution would need to be discarded.

Mechanical Difficulties

The flotation machine was fed by the underflow of three Caldecott de-sliming cones. These cones were fitted with an automatic-discharge control attachment which promoted excellent classification but gave a very intermittent discharge. When the three discharges happened to be synchronous the variation in the volume of feed coming to the machine was so large that efficient operation was impossible. Although this was pointed out before the plant was installed, no steps were taken toward rectification of the evil. By discarding the cones and utilizing a Dorr classifier the trouble could have been corrected, and also the difficulty with the mill water, already mentioned, would have been mitigated. As an expedient to meet the situation, I designed a different type of cone-discharge regulator. Discharge from the nozzle of the cone takes place round an internal conical plug and impinges on a disk. Friction on the plug and impact on the disk tend to shut off the flow, which tendency is opposed by the counterweight. As the velocity of the discharge increases the forces tending to closure increase and the discharge is throttled. When properly adjusted this control is in constant motion and maintains a fairly steady volume of discharge.

Inadequate Capacity of Machine

Even after the uneven feed difficulty had been overcome and the trouble from calcium hydrate had been righted, the tailing from the subaërator machine still contained much floatable pyrite, owing to the inadequate

size of the machine, rich froth coming from the last cells. After a long series of ineffectual experiments with the existing machine, the situation finally became desperate, and steps were taken to get the essential additional plant installed.

Design and Advantages of a Cascade Machine

As I had been convinced from the beginning that enlargement of the flotation machine eventually would be necessary, the design of a machine which had been devised for treating sand residues in conjunction with stope filling operations was perfected. The design finally adopted is shown in Fig. 3. Installation of this machine as an auxiliary to the standard subaërator was advocated because the matter of cost was all important, and in this regard it offered considerable advantages over all other types.

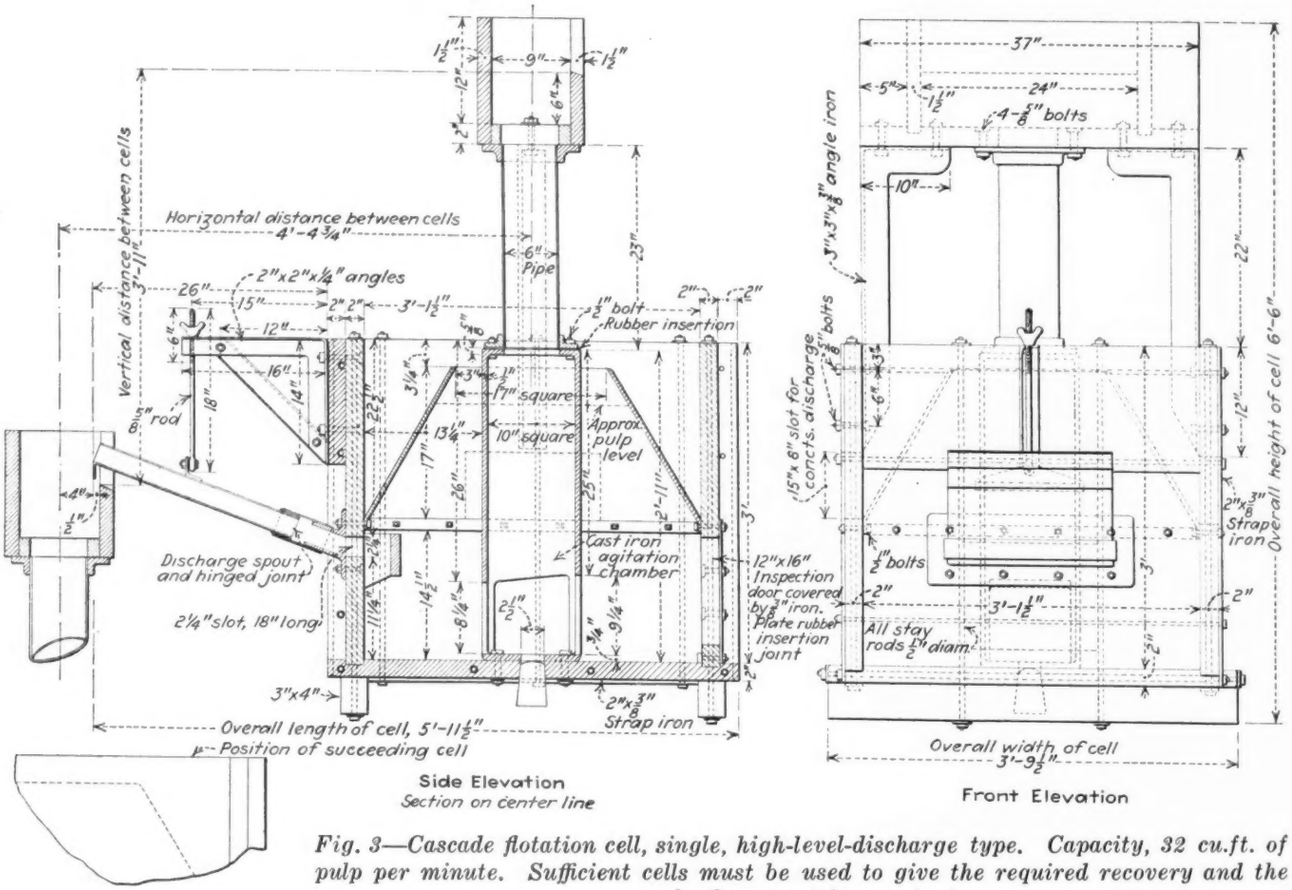


Fig. 3—Cascade flotation cell, single, high-level-discharge type. Capacity, 32 cu.ft. of pulp per minute. Sufficient cells must be used to give the required recovery and the pulp flow must be constant

One cell was first constructed in the mine workshops and tried out. It was so satisfactory that no difficulty was experienced in getting the expenditure authorized for the installation of a complete cascade plant consisting of: a steady-head tank, six cells in series echelon, and substructure consisting of a light latticed-steel framework in the shape of a right triangle, 28 ft. high, 27 ft. long, and 7 ft. wide, with the cascade cells mounted along the hypotenuse. The whole formed a compact, self-contained unit which could be set up on four concrete piers in any position. It was built and erected for $2,100. The subaërator tailing was elevated to the head of the cascade machine by a 4-in. sand pump, which consumed about 15 hp. and handled the pulp with ease. This plant started up without a hitch and ran without any attention, producing a large volume of froth which carried the pyrite well and broke down readily in the Dorr thickener.

Some doubts had been expressed about the ability of the cells to clear themselves, as all of the coarse sand had to discharge through the adjustable spout with a head of less than 8 in. These misgivings proved to be unfounded, as there was no choking so long as the proper volume of pulp was kept passing through the machine. Neither did the cells require draining after a shutdown provided the full volume of feed was turned with a rush and not let in gradually. The machine required no tuning up. On starting, by the time the pulp had reached the last cell the upper cells were discharging a full volume of froth. Wear and tear were practically nil.

In view of these characteristics the suitability of this machine for a plant in which operations would be intermittent, and low operating costs imperative, such as with sand residues used for stope filling, is obvious, and the results given later show that its metallurgical efficiency is equally as high as its mechanical efficiency. This is a point which is worth emphasizing, as, according to statements which have appeared in various textbooks, the metallurgical efficiency of cascade machines is low. This is quite contrary to my experience, which has been that a properly designed cascade apparatus will give results equal to any other machine as regards recovery, and superior in the matters of cost of upkeep, supervision, and power. The drawback is the headroom required, but this is unimportant in countries like South Africa, where the climate allows the machine to be

set up out in the open; even inside mill buildings a lot of waste space is usually available up between the roof trusses.

Cause of Deficient Capacity of Subaërator

Preliminary laboratory tests had indicated that three minutes' treatment was sufficient for the pulp, and the subaërator installed had sufficient volume to give this time of treatment, so that, had the full-scale plant been as efficient as the laboratory machine, additional frothing capacity would not have been necessary. In view of the occasional unsatisfactory performance of similar machines elsewhere, the reason for the discrepancy is worth close consideration.

In a laboratory machine the greater part of the pulp remains in the confined space below the grid, where it is subjected to intense agitation and the action of a continuous upward stream of bubbles for the whole period of the test. The grid is constructed so that the agitation is effectively damped and the froth zone is comparatively quiet. These are ideal conditions which do not obtain in practice with the type of machine under consideration. First, with the usual power consumption the agitation is not so intense. It was computed that the energy imparted to the pulp in the laboratory machine was six times as great as in the full-scale plant, which is a big difference even allowing for the relatively low mechanical efficiency of small apparatus.

Next, in order that the pulp can flow through a full-scale machine it must be kept in continuous motion both vertically and horizontally in and out of the zones of agitation. Also, if a type of baffle or grid is used which damps the agitation sufficiently to give a quiet froth zone, choking of the machine soon takes place. Hence, allowing for the time when the pulp is moving up and down through the grid and from one compartment to another, the period it is in the machine is not the time of treatment in the same sense as in a laboratory machine. And also, owing to the disturbance in the froth zone, mineral which may be called tender in the froth would be less likely to be saved.

By adopting a cell of different form and proportions the results can be made to compare closely with those obtained in a laboratory machine, but the design shown was adopted because at the time it was the flotation company's standard. With this type of machine, to duplicate the laboratory results on anything but a simple ore, the full-scale plant seems to require capacity at least 50 per cent in excess of that called for by the tests.

Wood Fragments and Rubbish in Pulp

Another difficulty which arose when the plant was put into operation was caused by chips and wood fiber in the pulp. These became agglomerated into balls and rope-like masses, which in time choked the machine. The trouble became acute when the step grids were replaced by the perforated plates, but was overcome by a device which I designed and which was installed in the stream of pulp leaving the tube-mill section. This was similar to the undercurrents used in hydraulic placer mining. The screen portion consisted of a $\frac{3}{16}$-in. mild steel plate, 6 ft. wide by 8 ft. long, perforated with standard $\frac{1}{4}$-in. holes. The plate had a fall of $\frac{1}{4}$ in. per foot and was curved at the bottom so that the edge stood up 1 ft. above the surface of the plate. The wood chips and fiber slid along the smooth surface of the screen and built up at the toe of the stream against the curved-up end, being removed at intervals by an attendant. This undercurrent handled easily 1,700 tons of solids contained in about 12,000 tons of water per twenty-four hours, and the quantity of wood and rubbish it collected was astonishing.

Dewatering Coarse Flotation Concentrate

Much trouble was experienced with the thickener used to dewater the concentrates previous to regrinding in cyanide solution. As already mentioned, dewatering was necessary to avoid excessive increase in stock cyanide solution. The thickener was a 25-ft. tank fitted with standard Dorr mechanism and a No. 4 Dorrco pump. When this pump was set to give a product containing 40 per cent moisture, the underflow would cease inside half an hour. The primary cause of this was the granular nature of the concentrate, but the fault lay in the size of the Dorrco pump. The normal capacity of this pump was 120 tons of solids per twenty-four hours, which was four times the amount of concentrate being produced. At reduced speed there was not sufficient movement in the underflow pipes to keep them clear, and if the stroke was shorter than $\frac{3}{4}$ in. the valves fouled. The trouble probably could have been overcome by installing a pump of such size that when run at from 40 to 50 $\frac{3}{4}$- to 1-in. strokes per minute it would deliver just the volume to keep the underflow at 60 per cent solids; and by reducing the size of the underflow pipes so that the minimum velocity of pulp therein would be 1 ft. per second.

An alternate scheme was to have a free underflow from a valve fitted to the discharge cone at the center of the tank bottom, and to run this by way of a launder to the boot of an elevator which would raise it to the tube-mill scoop. One or the other of these methods would have been employed had the plant continued to operate.

Results from Trial Plant Improved by Experimentation

With coarse granular concentrate it might appear that a thickener was unnecessary and that the concentrates could have been collected in bins and dewatered by tamping in the manner employed elsewhere. But this scheme was not feasible, as the froth was so tough at times, owing to free lime in the pulp, that the area of the whole surface of the 25-ft. thickener was hardly sufficient to allow it to be broken down.

The sand treated had an average gold content of 4.8 dwt. per ton, partly in the form of fine free gold which had escaped amalgamation, partly as gold incased in gangue, and partly as gold associated with pyrite, which was present to the extent of 2.3 per cent.

Without the use of sodium sulphide, and with the subaërator machine alone operating, the recoveries were gold, 51.8 per cent, and pyrite, 52 per cent. After the removal of this amount of gold and pyrite, the cyanided sand residues contained 0.45 dwt. per ton, as against the normal value of 0.55 dwt. per ton for sand which had not been subjected to preliminary flotation treatment.

By the use of $\frac{1}{8}$ lb. of sodium sulphide per ton, the recoveries were improved to gold, 57 per cent, and

pyrite, 88 per cent, and the cyanided sand residues fell to 0.38 dwt. per ton. The increase in recovery of gold in the flotation machine is seen to have lagged much behind that of the pyrite. This is because of the gold, which is unavailable to flotation owing to gangue incasement. But the additional extraction of pyrite is well reflected in the sand residues, which show an increased recovery of gold to the extent of 13 per cent. The presence of fine free gold, which floats very readily, accounts for the recovery of gold and pyrite being practically identical when flotation conditions are poor, as was the case before the addition of sodium sulphide.

Tests in a laboratory apparatus on the pulp passing through the machine showed that it was possible to reduce the content of the average flotation tailing to about 1.7 dwt. gold and 0.12 per cent pyrite, with about 4½ per cent of concentrates assaying 75 dwt. per ton. This represents a recovery of 66 per cent of the gold and 95 per cent of the pyrite. With such results, a cyanided sand residue containing 0.3 dwt. per ton, or somewhat less, could be expected.

The last traces of pyrite—that is, the particles most refractory to flotation—seemed to be the more highly auriferous portion, since an increase in pyrite extraction from 88 to 95 per cent causes the gold extraction to increase from 57 to 66 per cent, whereas an increase in pyrite extraction from 52 to 88 per cent resulted in the gold extraction increasing only from 51.8 to 57 per cent.

Fairly consistent high extractions of pyrite were shown in the operation of the trial plant, but occasionally the extraction of gold was much below normal. At such times the gold in the concentrate fell from the usual 75 to 80 dwt. per ton to as low as 50 dwt., which indicated that the proportion of gold associated with the pyrite had decreased, with a corresponding increase in the gold embedded in the gangue. As was to be expected, on these occasions an improvement was reflected in the extraction made by the cyanide leaching plant. The importance of the removal of the last trace of pyrite is therefore apparent, and if the flotation plant could be made to perform this function satisfactorily, the recovery of the residual gold could be safely relegated to the cyanide plant.

Until the cascade machine was installed the extraction of pyrite had never been satisfactory except for short periods when either the pyrite in the original sand or the quantity of sand passing through the plant was much below normal. But this machine proved so efficient that after it was started up the sand leaving the flotation plant contained practically no free pyrite, provided the correct flotation conditions were maintained. Some typical figures showing the work done by the cascade machine are shown in Table I.

Table I

Cascade Head (Subaërator Tailing) Pyrite, per Cent	Cascade Tailing (Sand-Tank Charge) Pyrite, per Cent
0.29	0.13
0.45	0.15
0.25	0.11
0.33	0.15
0.26	0.11
0.24	0.13
Average 0.30	Average 0.13

Neglecting the weight of the concentrate, which was an inappreciable proportion of the material treated, these figures show an average recovery of 56.6 per cent of the refractory residual pyrite remaining in the subaërator tailing, and taking 2.3 per cent pyrite in the original sand and 4½ per cent of concentrate removed, a combined extraction by subaërator and cascades of 94.5 per cent of the total pyrite in the sand is indicated.

Owing to delays and shutdowns at the trial plant, mostly in connection with the makeshift concentrate-handling section, it was difficult to get a series of consecutive sand tanks completely charged with flotation-treated sand so that the actual reduction in the gold content of the sand residues due to the use of flotation could be accurately determined over a suitable period of time. But with everything running in good order it was shown that a sand residue containing 0.3 dwt. of gold per ton, or slightly less, could be produced, which proved that the laboratory results could be reproduced on a practical scale.

Osmiridium in Flotation Concentrates

All the auriferous banket reefs of the Rand area contain small amounts of platinoids, mostly in the form of osmiridium, and on the Far East Rand the quantity is sufficient to make it an economic constituent of the ore. After this fact was recognized, all concentrates obtained from various pockets and traps in the plants were treated for the recovery of the osmiridium content. At the property under consideration, osmiridium to the value of $25,000 was recovered in this manner during 1924.

The amount of osmiridium recovered by the usual methods employed can represent only a small proportion of the total quantity present in the ore, and as the metal will not amalgamate and is insoluble in cyanide solution, the remainder goes to waste, mostly with the sand. In the plants where the amalgam plates have been displaced by blankets, an enhanced recovery of the osmiridium is made, but heavy losses must still take place, especially of the finer sizes. As the platinoids are known to be readily floatable the flotation concentrate could be expected to contain an appreciable amount of osmiridium, and tests proved this to be true. Concentrating tables were erected in the concentrate treatment circuit and a certain amount of platinoids were recovered, but owing to mechanical troubles in this section the tests on osmiridium recovery were not brought to a definite conclusion. Assays on samples of flotation concentrates showed, however, that the osmiridium content was sufficient to make recovery both practicable and profitable, and the extra revenue derivable from this source is a distinct incentive to the use of flotation.

By the time the trial flotation plant had been brought to the state of perfection where it could perform its function of the recovery of the pyrite from the sand efficiently, further refinements in milling and cyanide practice had resulted in the residues being reduced to such a figure that the recovery by standard methods of treatment was over 97 per cent. This reduced the margin in which the flotation plant had to operate at a profit to such small dimensions that the management decided it was not worth while to continue to use flotation as a part of the regular treatment scheme, so the plant was closed down as soon as the full-scale test was brought to a satisfactory conclusion. Hence, the efforts hereinbefore described did not result in the adaptation to Rand metallurgical practice of flotation on a commercial scale, but had the attempt been made under more favorable auspices, and at a property where

the nature of the current residues left more scope for improvement in recovery, the result, in all probability, would have been different.

The hundreds of millions of tons of gold-bearing residues which are stacked along the 60 miles of outcrop of the Rand banket reefs offer a tempting field for re-treatment processes, but with the exception of several relatively small cyanide plants which have been operated on limited dumps of old tailings which were stacked before latter-day refinements in cyanidation were introduced, all attempts in the past have been financial failures. This was chiefly because of the prevailing low gold content of the bulk of the residues, but some of the older dumps contain sufficient gold to cover the cost of re-treatment and leave a margin for profit if an efficient and economical process were available. For the purpose of determining whether flotation could supply the need, tests were made on samples from some of the richer sand dumps. Typical results are shown in Table II. After regrinding the sand to

Table II

Results of Treatment of Accumulated Residues by Flotation

	Weight, per Cent	Assay Value, Dwt. per Ton	Percentage of Total Gold
Sand treated	100.0	1.45	100.0
Cleaned concentrate	1.21	96.0	80.0
Middling (cleaner tailing)	5.83	1.0	4.0
Residues	92.96	0.25	16.0

Extraction in concentrate and middling: 84.0 per cent, or 1.2 dwt. per ton. (Note: The return of such low-grade middling made no difference to the recovery.)
Ratio of concentration, 82.6 to 1.
Fineness of grinding, 5 per cent plus 90 mesh I.M.M.
Reagents, lime to make pulp faintly alkaline added to pebble mill.
Gas coal tar, 1 lb. per ton added to pebble mill.
Pine oil, (steam distilled) ¼ lb. per ton added to flotation machine.

5 per cent plus 90 mesh, high-grade concentrates were produced containing a large proportion of the gold.

It was estimated that under favorable conditions sand containing 1 dwt. of gold per ton could be treated with a margin of profit, and sand containing 1.5 dwt. per ton was distinctly attractive. Many Rand engineers believe that if the returns from the top portions of these old dumps were sufficient to cover the cost of the removal thereof, the profits derivable from the enriched lower layers and from the ground under the dumps would make the operation a lucrative one. However, various factors demand special consideration before re-treatment is decided on.

For instance, the disposal of residues after re-treatment is a knotty problem. Most of the older dumps are situated in populous districts where fresh dumping space is difficult to acquire and where vested interests are strongly opposed to the building of new tailing piles. This difficulty could be overcome on a property where there are open abandoned workings into which the tailing could be run.

The sand must be reground to obtain a satisfactory extraction of the gold, and the amortization of the capital expended on a new regrinding plant makes a big item in operating expenses. If the old dump is in proximity to an abandoned reduction plant with tube mills intact, this item could be eliminated. Also the amortization charges on the cyanide plant for concentrate could be saved if the dump re-treatment plant was being operated by a company with adjacent cyanide works to which the concentrates could be shipped.

The old dumps have developed considerable acidity, which must be neutralized, both to allow effective flotation concentration and to prevent excessive corrosion of machinery. A supply of suitable water must be available, as the purchase of water from the Rand Water Board would increase working costs unduly, and water cannot be too closely conserved, on account of the accumulation of sulphates in solution.

These are some of the more important points which have to be taken into consideration in connection with dump re-treatment schemes, and although they restrict the field for profitable operations considerably, among the great number of tailing piles there are many so situated, and of such value, that re-treatment in a flotation plant should yield a profit, with good chances of handsome returns from the enriched lower layers and underlying soil.

Conclusion

Owing to the near approach to perfection to which the technology of ore reduction and gold extraction has been brought on the Rand, nothing much further can be expected in the way of enhanced profits by improvements in orthodox practice. Hence, further profitable reduction in tailing losses is most likely to be effected by innovations, and the tests and trials described in the foregoing pages show that flotation concentration must be assigned a foremost position among any novel schemes brought forward.

Since the tests and trial herein described were conducted, important advances have been made in the art of froth flotation. The efficiency of apparatus has been increased, and new reagents of great potency have been developed, notably potassium xanthate, which makes possible the flotation of pyrite in circuits containing inhibitory substances such as lime and cyanide. So that, with the advantages of this improved technic, and under discerning flotation, further attempts should result in froth flotation being firmly established as an important adjunct to future Rand metallurgical practice.

Canada Makes Record Salt Output in 1925

In 1925, the production of salt in Canada exceeded all previous records, according to final statistics just issued by the Mining Branch of the Dominion Bureau of Statistics at Ottawa. Shipments during the year totaled 233,764 tons, compared with 207,979 tons produced in 1924. There was a considerable decline in value during the year, the average price of all grades being $6.04 per ton, against $6.61 in 1924.

The production in Ontario amounted to 226,315 tons, or 97 per cent of the total; Nova Scotia and Alberta contributed the remainder. Alberta's shipment of 833 tons came from the Fort McMurray district, where development work in the salt industry has been carried on for a considerable time. Nova Scotia's production consisted of salt mined at Malagash.

Imports into Canada of salt, all grades, were equal to 83 per cent of the total Canadian production. Customs records show that 192,632 tons, worth $1,077,321, was brought into Canada during 1925. Exports of Canadian salt totaled 2,324 tons; in the preceding year only 965 tons was shipped from Canada.

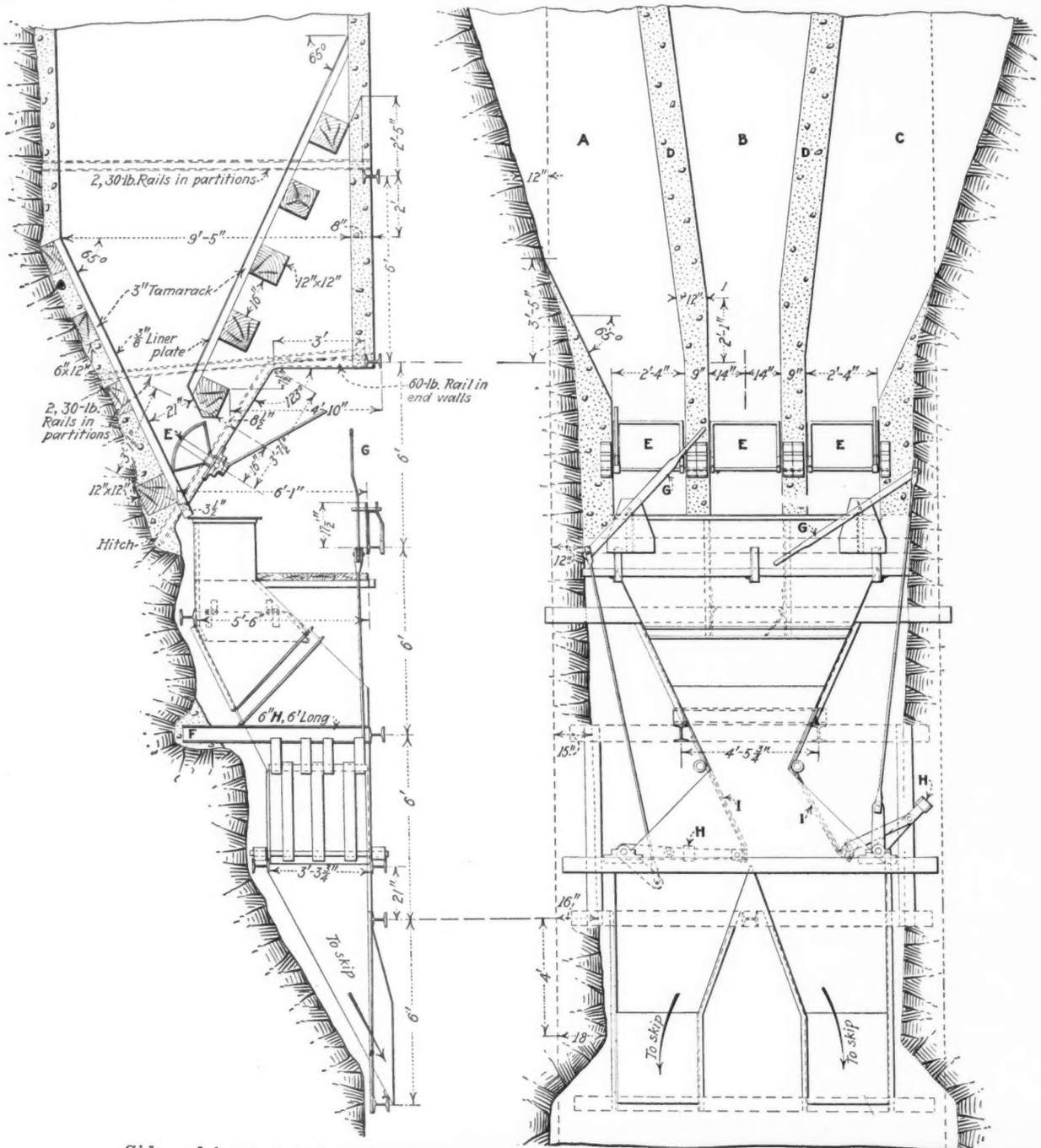
The twelve companies operating in Canada during 1925 reported a capital investment of $2,563,508. Salaried employees numbering 57 and wage earners to a total of 345 were engaged in this industry during the year. The salaries and wages paid amounted to $67,487. Fuel costs accounted for an outlay of $296,229 while the electric power consumed added $19,139 to the total operating expenditures.

Useful Operating Ideas

New Shaft-Measuring Pockets

By A. W. Foss

In most shafts it is customary to have one measuring pocket for each skip. The usual practice, when there is more than one compartment in the main pocket, which is served by two skips, is to divert the ore from either compartment to either skip by means of a swinging gate at the top and between the two measuring pockets. This method is quite satisfactory when the main pocket has only two compartments: likewise, when it has three compartments, provided it is not necessary to hoist ore in either skip from each of the three compartments. If only two or three grades of ore are mined it may be necessary to divert only that from the center compartment into either of the skips. In this case a short swinging gate placed between the two measuring pockets will operate satisfactorily.



Side and front elevation of measuring pocket at Eureka Mine, Gogebic Range, Michigan

When the main pocket has three compartments which are served by two skips, and it is desired to hoist with either skip from any one of the three compartments, difficulties will be encountered if two measuring pockets are used. A long swinging gate in place of the short one described above, pivoted between the measuring pockets and capable of reaching to the far side of the end compartments of the main pocket, will be necessary. This is an unsatisfactory arrangement, because the gate would be too heavy to operate by hand and the measuring pockets would have to be placed the entire length of the gate below the main pocket. That distance would be too great for the efficient loading of skips. It would be a matter of guesswork as to whether or not the measuring pocket was full, and the result would be that a considerable quantity of ore would spill into the shaft. Spill pockets are built in most shafts to handle this material, but extra work is required to clean them, and often they become full while hoisting.

The accompanying illustration shows a recent installation at the Eureka mine, on the Gogebic iron range, in Michigan. At this mine three grades of ore and two grades of rock may eventually be handled through one pocket served with two skips. Speed and flexibility are very important. As shown, the main pocket has three compartments *A*, *B*, and *C*, separated by reinforced-concrete walls, *D*. An arc gate, *E*, controls the flow from each of the compartments. The measuring pocket is built as close to the main pocket as will permit the operation of the arc gates and poking with a bar when it is necessary to dislodge a chunk. The volume of ore in the measuring pocket is controlled by its angle of repose and two hinged partitions at the top, so that the pocket will not contain more than a skipful of ore.

The full advantage of this arrangement is obtained when loading ore into railroad cars on the surface. Each compartment of the main pocket contains 50 tons, which is the capacity of one standard railroad ore car. Both skips can be used to hoist the same grade of ore until a car is filled. The car can then be replaced and another grade hoisted without interruption until that car is filled. Likewise, when hoisting rock it is convenient to hoist with both skips so that the pocket can be quickly emptied and filled with ore.

The measuring pocket and chutes are built of ¼-in. steel plate with 3 by 3 by ⅜-in. angle iron on the inside corners. Plow bolts are best adapted for attaching the angles and wearing plate, as they are countersunk and permit the ore to ride over smoothly. The measuring pocket is bolted to the shaft steel and supported by 6-in. H-section steel which is hitched in the rock, *F*. The doors, *I*, are made of ½-in. plate and are opened from the operator's floor by means of levers, *G*, attached to toggles, *H*. The bearings for both the arc gates and toggle shafts are babbitt lined.

Only one disadvantage in this measuring pocket was encountered after placing in operation. Sticky ore had a tendency to hang in the corners just below the doors. This ore would build up and prevent the doors from closing. The difficulty was overcome, however, by rounding the corners of the chutes inside with bent plate and burning off the corners of the doors. Had this difficulty been foreseen the chutes could have been made vertical for some distance below the doors and extended to the next shaft set.

How to Clean the Oil Reservoir of a Gasoline Engine

By G. S. Hamilton
Climax Engineering Co., Clinton, Iowa

Once every year it is desirable to drop the oil pan and thoroughly clean the reservoir of a gasoline engine. Simply changing the oil in the crankcase is insufficient. After a certain length of time, sediment will accumulate, and only a thorough cleaning will remove it. Many operators may be familiar with the details of cleaning the reservoir, but for the new user of industrial gasoline engines the following instructions will be helpful:

1. Clean outside of pan to keep grit out of crankcase when open.
2. Drain off old oil.
3. Remove the oil-pan stud screws and bolts.
4. Drop pan, being careful not to damage gasket.
5. Wash out oil pan with kerosene or gasoline and dry out with lintless cloth. Do not use waste. The threads and lint are likely to clog the oil ducts.
6. See that crankcase gasket is in good condition, and in proper position. If necessary, replace with a new one.
7. Cement gasket tightly to oil-pan flange, using shellac.
8. Cover upper face of gasket with grease or hard soap soaked in water. This will check leakage and permit oil pan to be removed when necessary without breaking the gasket.
9. Replace pan and tighten screws and bolts, tightening a little at a time on each one to distribute the strain evenly.
10. Refill oil reservoir with proper amount of fresh oil of correct grade and see that indicator registers "full."

Lime Circuit at Magna Mill

At the Magna mill of the Utah Copper Co. lime is ground in a conical ball mill in closed circuit with a rake classifier, the overflow being piped to two large steel storage tanks in the upper part of the fine-crushing division of the mill. A twenty-four-hour supply is maintained. The tanks are equipped with slow-moving agitators on vertical shafts driven by vertical motors and speed-reducing gears. The two tanks are equipped with a pair of direct-driven centrifugal pumps, which discharge into a common launder over the lime feeder and maintain a constant level of milk of lime in the feeder box. The feeder box contains a horizontal shaft carrying a series of metal disks; on both sides of each disk, except the end disks, are metal buckets which dip into the lime hydrate solution and discharge the lime into separate launder outlets. These end disks are provided with buckets on one side only. The shaft is driven by a motor and speed reducer. The speed reducer permits of twelve variations in the speed of the bucket shaft. Wooden launders convey the lime solution to the bucket elevators receiving the undersize of the impact screens. The mill circuit is tested every half hour for alkalinity and the feeder adjusted accordingly. One man on each shift makes the alkalinity tests and feed adjustments. Tests are made with phenolphthalein indicator and a standard sulphuric-acid solution.

Discussion

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Chemistry of Ore Solutions

THE EDITOR:

Sir—It has frequently occurred to me that in the discussions of the genesis of ore deposits, and more especially those of the sulphide and allied ores, we are too prone to slight or even entirely pass by the physico-chemical features involved in the processes. We speak of the magmatic fluids as carrying in solution the metallic sulphides, oxides, and so on, whereas the physical chemist would find it much more logical to think of these fluids as solutions carrying the dissociated ions of the metals and the salts. In a superheated fluid, or even in one subjected to ordinary heating, the individuals tend to break down to form smaller units, and we have our molecules destroyed to give way to the smaller and more compact ion. In fact, pressure and heat are the great natural accelerators of dissociation.

Then let us consider the early phases of a solution which might, under later favorable conditions, form a deposit of one or more of the metallic sulphides. With the attendant high-heat and high-pressure conditions the comparatively cumbersome and bulky molecule will lose its identity, to be superseded, if it has ever existed, by its component ions in a state of dissociation. Such a solution would be neutral in character, but acid in reaction, due to the presence, in excess, of the hydrogen sulphide. Bearing in mind the vigor with which such solutions attack limestones and allied carbonate rocks, and the great degree of disturbance of the solution's equilibrium at such contact, manifested by the ores precipitated out, one is inclined to believe that the original nature of the fluid was as above. Such at least is the belief held by the writer, that a fluid of deep seated origin, on its upward and outward journey into the zone of fracture, is originally a superheated solution carrying the ions of the metals and the salts in a dissociated state, ready to unite to form molecules of the metallic sulphide upon any change of condition affecting the equilibrium of the fluid; and that such a solution, if it is of such character as eventually to form a sulphide ore deposit, must of necessity originally be of acid reaction, due to the presence, in excess of hydrogen ions formed from H_2S. Doubtless at the same time we have some of the more inert metallic minerals, such as magnetite and franklinite, existing as simple solutes, their molecular integrity preserved due to their lesser susceptibility to the disrupting forces.

Some thirteen or more years ago, Spencer, after his study of certain ores in Nevada, was of the belief that at least some of the ores of the district must have been formed by magmatic waters of acid reaction.

Fort Banning, Ga. W. R. GRISWOLD.

Tin in the Malay States

THE EDITOR:

Sir—In a recent number of the *Engineering and Mining Journal-Press* F. R. Koeberlin expresses his opinion that secondary enrichment has been effected in Bolivian lodes by the solution and re-deposition of cassiterite, and he invites geologists in other tin-producing countries to give any evidence on the subject, positive or negative, that they may possess.

In British Malaya not only is there no evidence of secondary enrichment by the solution and re-deposition of cassiterite in tin deposits such as the lodes worked by the Pahang Consolidated Co., the Menglembu Lode Syndicate, and numerous deposits in limestone, but there is no evidence of any lode deposit containing cassiterite being of hydrothermal origin, which has been claimed, apparently with good reason, by Dr. Takeo Kato for copper-tin veins in the Akénobé district of Japan (*Journal of the College of Science*, Imperial University of Tokyo, Vol. 43, Art. 5, May 10, 1920). This is of particular interest, because in 1890 Mons. Stanislas Meunier claimed, in *Compt. Rend.* J. 110, p. 1085, to have proved the deposition of cassiterite from the water of a Malayan hot spring. This claim was completely disposed of by Dr. Bott, Dr. W. R. Jones, and Mr. C. Salter (vide *Geological Magazine*, 1914, pp. 537-541), but it is still wrongly quoted as evidence of the solubility of cassiterite, for instance by Dr. F. W. Clarke in the fourth edition of "The Data of Geochemistry," 1920. An experiment which I conducted and which extended over a year, on the solubility of finely ground cassiterite in ordinary ground-water, gave a negative result.

Never having visited Bolivia I do not wish to comment on the evidence Mr. Koeberlin puts forward: I can only say that in British Malaya we have no evidence of secondary enrichment by the solution and re-deposition of cassiterite.

J. B. SCRIVENOR,
Geologist, Federated Malay States.
Batu Gajah, F. M. S.

The Belmont Mine

THE EDITOR:

Sir—I have observed, on page 24 of your issue of July 3, a paragraph describing the activities of the Tonopah Belmont Development Co. of Tonopah, Nev. Reference is made to the Belmont mine, at Superior, of which Mr. Chester Hoatson is superintendent. For your information, we desire to inform you that the mine referred to at Superior is the property of the Belmont Copper Mining Co., an Arizona corporation, and that there is no connection between it and the Tonopah Belmont Development Co., which we understand recently acquired some property near Wickenburg and which apparently is a Nevada corporation.

Superior, Ariz. ARTHUR J. SMITH,
Belmont Copper Mining Co.

News of the Week

The Mining News given in ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

U. V. X. and Katanga companies acquire interest in Nichols Copper—Wenden Copper to sink shaft 400 ft. deeper.

Kirkland Lake power service to be improved—Crown land grants held valid in favor of Premier Paymaster Mines—Pilot smelter for Flin Flon assured—Assessment work, Red Lake, Ontario, being rushed to completion by Sept. 1.

Wade mine, Kinney, Minn., sold under foreclosure—Keweenaw Copper enlarges holdings—Serious air blast at Quincy mine.

Moctezuma branch, Phelps Dodge Corporation, has best "safety first" record.

Joplin-Miami district has 251 mills, 155 of which are in operation.

Bureau of Mines hampered by lack of funds—Committee appointed to investigate financing of German steel exports—Swedish and Austrian iron and steel industry depressed.

Big Jim completes flotation plant—Calumet & Arizona yield increased by new ore discoveries — Mono mills 22-oz. silver ore.

Alaska Juneau has $28,300 deficit for June—Cariboo District, B. C., placer production estimated at $500,000 per year.

Rand Mines sustain profits with decreasing ore value —New tin deposits reported in Burma — Lydenburg platinum mill begins operation.

Profits of Consolidated Mining & Smelting Co., in excess of five million dollars for half year.

Half-Year Operating Profit of Consolidated Mining in Excess of $5,000,000

The Consolidated Mining & Smelting Co. of Canada estimates that, after providing for depletion, depreciation, contingent account, and taxes on the basis of last year's statement, and after deducting $677,144 for additions to property, it made an operating profit of $5,638,237 during the first half of the present year. Computed in the same way, the net operating profit for the first half of 1925 was $3,960,763, after deducting $1,327,723 for additions to property. The profit for the first half of this year is equivalent to 37.6 per cent on the company's outstanding capitalization, or if the deduction for additions, which rightly is part of the profit, be considered, it amounts to 42 per cent. To June 30 last the company received at its smelter 274,518 tons of ores and concentrates and it produced approximately 122,530,000 lb. of lead, 59,698,000 lb. of zinc, 11,922,000 lb. of copper, 3,306,539 oz. of silver, and 27,726 oz. of gold.

The company's profits for the second half of the year should be considerably greater, as the new 1,000-ton unit to the Sullivan mine concentrator will be put into operation in the near future, and the new 500-ton mill at the company's St. Eugene mine, at Moyie, recently was put into operation on the old tailing and waste dumps, and concentrate from this source now is reaching Trail. Mining activity throughout the Kootenays is increasing rapidly and profits from custom business form a considerable part of the company's total profits.

Rushing Assessment Work at Red Lake

THERE is great activity among prospectors and claim owners in the Red Lake division of northern Ontario, as their assessment work has to be completed by Sept. 1 to avoid forfeiture of their claims. A large number of laborers are coming into the region to assist in the work, notwithstanding which some scarcity of labor is reported.

To avoid an epidemic of typhoid fever such as sometimes occurs in mining camps owing to defective sanitation, strict sanitary regulations are being enforced in the principal camps and stations en route. The Ontario Government has several parties of men engaged in widening and clearing the numerous portages along the water routes to enable supplies and heavy machinery to be more easily transported to the mining camps. The recording of claims indicates that the principal center of interest at present is the Narrow Lake section of the Woman Lake camp, where a promising free gold discovery was made on the Dunkin-McBain group last month.

The Noranda Mines, Ltd., is interested to a considerable extent in the Red Lake camp, where it has a number of different groups of properties either under working options or agreements of a similar nature, on which some promising discoveries have been made.

International Smelting Co. Developing Property at Eureka, Utah

The sum of $30,000 has been appropriated by the International Smelting Co. for development of its North Lilly property, consisting of 120 acres at Eureka, Utah, just west of the west sideline of the Tintic Standard mine and adjoining the Eureka Lilly. Work will be done by the Tintic Standard Mining Co. by drifting northwest from the 700 level of its No. 2 shaft. As a result, exploration by the Internationa' Smelting Co. will develop 1,000 ft. of Tintic Standard ground and several hundred feet of the Eureka Lilly estate.

Diamond drilling done several years ago by the International Smelting Co. on North Lilly ground proved that block faulting had dropped the Ophir shales and limestones down into the quartzite, practically duplicating the condition surrounding the Tintic Standard.

The Chief Consolidated Mining Co. has started drifting in a fissure traversing the limestone on the 500-ft. level of its Eureka Lilly property. This means that two companies will explore relatively the same territory cut by the intersection of three major mineral channels, thereby accomplishing much to clear up the mystery surrounding the origin of the Tintic Standard ore deposits, and either prove or dispose of one of the theories of East Tintic mineralization.

In addition to its North Lilly interests the International owns in the Tintic district fourteen-fifteenths of East Tintic Coalition Mining Co., as well as a bond and lease on the Addie group and a lease on the Yankee property.

Tri-State District Has 251 Mills, of Which 155 Are Operating

As the result of a careful check-up by the Tri-State Zinc and Lead Ore Producers' Association, it has been found there are not fewer than 251 concentrators in the Joplin-Miami district, all but fifteen of which could be rehabilitated and placed in operation within a few weeks' time. At present 155 mills are in active operation in the field, which apparently means that the district is being operated at only about 61 per cent of capacity.

An exceptionally high price for zinc would have to exist, however, before more than 200 mills would be placed in operation. Early in the year, with ore at $55, 186 mills were active, and this established a record; but at this figure it is unofficially estimated that not more than 150 of the 186 were really making a profit on operations.

If zinc-ore prices should advance to $60 a ton it is believed that 195 of the mills would be placed in active operation, but it is doubtful whether many of the remaining 56 would be set at work with ore at less than $100. A good many of them have no ore deposits on which to work.

The old Underwood and Squires mine, which is at 26th and Picher streets, Joplin, has been taken over by the H. & C. C. Mining Co. A three-inch pump has been installed, and the plant will be placed in immediate operation. The same company took over the old Imperial mine, west of Joplin, several months ago, developed it into a good producing property, and sold it to the C. & S. Mining Co. for $125,000.

Fire destroyed the Rogers concentrator, on the Parker land, southeast of Carthage, Mo., on the night of July 27. The loss was about $25,000, about half covered by insurance. The mill, which was in operation up to the time of its destruction, was built about a year ago, following the drilling out of the lease by the Universal Explorations Co., a subsidiary of the U. S. Steel Corporation. It probably will be rebuilt.

Swedish Iron and Steel Industry Still Depressed

The depression in the Swedish iron and steel industry is reported to have been greater in May with regard to both price and demand, according to advices to the U. S. Department of Commerce. The principal reasons are said to be the English coal strike and the inflation of the French and Belgian currencies. A number of iron works, the principal one being the Fagersta Bruks A-B., which has just been taken over from the A-B. Kreditkassan by the A-B. Svenska Handelsbanken, are going to be consolidated by the last named.

During April, operations were resumed at a number of the iron works, the total number of furnaces in operation at the beginning of May being 152, as against 137 a month earlier. In comparison with a year ago, however, there was a considerable decrease, 200 furnaces having been running on May 1, 1925. The output of iron and steel continues to show a decrease in comparison with 1925.

Calumet & Arizona Doing Well

THOUGH New Cornelia has passed its parent company as regards production, nevertheless the Calumet & Arizona, with its new ore finds and dividends from the Ajo plant, is doing remarkably well. In the Cole district an entirely new ore zone has been discovered, between the 800 and 1,100 levels, and in the deepest levels of the Junction and Denn shafts good ore is being taken out from the 1,600 to the 2,000 level. The company has been making many improvements around the Junction shaft, its main outlet, and is operating a new electric hoist for men and materials.

At Douglas, smelting now is wholly by reverberatories, which practice affords a supply of cheap power from the waste heat of the furnaces. Little sulphuric acid is now being produced, as leaching is on the decline at Ajo since the establishment of the mill at that point and the working out of most of the surface bodies of oxidized ores.

New Cornelia is now turning out about 7,500,000 lb. of copper monthly.

U. V. X. and Katanga Reported to Own a 40 Per Cent Interest in Nichols Copper

It is reported that the United Verde Extension and Katanga copper interests have purchased approximately 40 per cent of the 70,000 shares of the Nichols Copper Co. outstanding, the Jerome company having taken around 20,000 shares, while the African company received 10,000. The United Verde Extension is now assured of a permanent refinery for its copper, and it is understood that the Katanga company will make substantial shipments of copper to the Nichols company, which has hitherto been sent to a refinery in Belgium. The Nichols Copper Co., operating an electrolytic refinery at Laurel Hill, Long Island, N. Y., has a capacity for handling about 45,000,000 lb. of copper monthly.

Wenden Copper to Sink 400 Ft. Additional

Development work is progressing satisfactorily at the Wenden Copper Co., Wenden, Ariz. The Barkdoll shaft has attained a depth of approximately 825 ft., and a contract is reported to have been let to W. A. Buchanan to continue this shaft to the 1,200 level, approximately 400 ft. deeper. Careful sampling of the shaft is reported to have disclosed gold values, the average of this metal content being $7.80, with copper present to the extent of 4.26 per cent.

In further development of its property the company will sink a third shaft. This will be sunk on the west end of the group and is to be connected with the Barkdoll shaft. It will require about ten months to complete this work, which is said to be fully financed.

Big Jim Mines Completes Flotation Plant

The seventy-five ton selective flotation plant at the Big Jim Mines in the Patagonia district of Arizona has been completed and is now in permanent operation. A test run of several weeks has been made at the mill, in which an average extraction of 92 per cent of the lead and silver values was obtained. The mine is said to have four oreshoots developed which contain 80,000 tons of ore. The company is incorporated as the Big Jim Mines, Inc., under the laws of Arizona, for $300,000. A. J. Keating, of Los Angeles, is president of the company and W. J. Loring, of San Francisco, vice-president. Mr. Keating is also general manager of the Gold Dust Mine, at Oatman. This latter company recently placed in operation a fifty-ton cyanide mill. The mine is said to have a total of 40,000 tons of gold ore blocked out on the first, second, and third levels. The main shaft has been deepened to the 500 level. Only a little development work has been done on the lower levels.

Keweenaw Copper Enlarges Holdings

The Keweenaw Copper Co., Calumet, Mich., which recently absorbed the Washington Copper Co., also will take over the Humboldt Copper Co., which will wind up the affairs of all of Keweenaw's subsidiaries. In acquiring the Washington property, Keweenaw gained 1,100 acres of mineral and timber lands in Keweenaw county, Mich. Belief exists in mining circles in the Michigan copper district that eventually there will be a merger of certain properties now idle in Keweenaw county, involving companies other than the Cliff, which is controlled by Calumet & Hecla. Prominently mentioned as included in such a consolidation are Keweenaw Copper, Ojibway, Copper Falls, and Miskwabik.

Alaska Juneau in June

Alaska Juneau reports reduced tonnage in June, 1926, because of labor difficulties. There was mined and trammed to mill 261,700 tons, yielding $137,500, or 52.54c. per ton; operating expenditures totaled $135,300, or 51.7c. per ton, leaving an operating surplus of $2,200, or 0.84c. per ton; other expenditures and accrued charges totaled $30,500, resulting in a deficit of $28,300 for the month. The addition to the milling plant is reported 81 per cent completed and Ebner preliminary work 85 per cent completed.

Hecla Bonds B. C. Prospect

The Hecla Mining Co., of Wallace, Idaho, has bonded the Imperial group, situated at Rock Creek, in the Boundary division of British Columbia, for $75,000, and has made an initial payment of $15,000. A 10-ft. vein, well mineralized with sphalerite and galena and carrying high silver values in places, is being developed. The company has ordered a compressor plant and has let a contract for 500 ft. of tunneling.

Night shift crew, Southwest Mine, Copper Queen Branch of Phelps Dodge Corporation

Phelps Dodge Corporation Strong on Safety Work

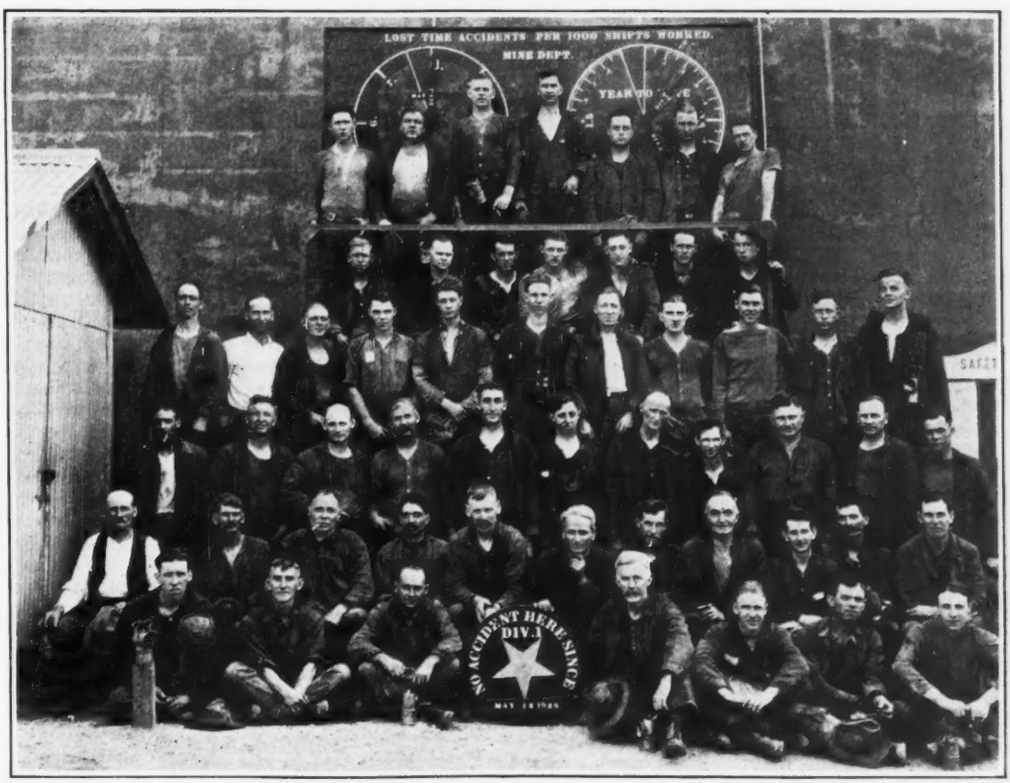
The four branches of the Phelps Dodge Corporation in the Southwest are carrying on vigorous campaigns to reduce accidents. Last year a safety organization was formed which is headed by the corporation's managing director and embraces all departments whose work is hazardous. Interest in the work of promoting safety is kept up by means of publicity, first-aid contests, safety bonuses, and safety committee meetings. Accident records are posted regularly on blackboards in conspicuous places in each department. Each month the standings of the four branches are published. For the month of June the Moctezuma branch, at Nacozari, Mexico, stood first, the Copper Queen, of Bisbee, second, the Morenci branch third, and the Old Dominion, of Globe, last.

During May a total of 22 men employed at the Sacramento shaft of the Copper Queen branch worked 5,478 shifts without a lost-time accident. This was the first time that one of the larger divisions of the Copper Queen has made such a record. The training department and Division 8 have each established this record previously, but these divisions have much smaller crews than the Sacramento shaft.

On July 10 the crew of Division 1 of the Southwest mine celebrated the fact that they had not had a lost-time accident since May 18 by having their picture taken. This division totals about 240 men. With a view to stimulating, at one and the same time, aid for the Globe ball team and further reduction of the accident record at the Old Dominion mine, W. G. McBride, general manager, has issued the following notice to the employees:

"In order to enable employees of this company to assist two worthy causes without financial burden to themselves, and also in order to further promote interest in safety work, the following order is hereby issued:

"If, on and after the morning of July 16, there are no time-lost accidents during any seven consecutive days, the company will pay $25 each to the baseball club and the Employees' Relief Association. If there are no time-lost accidents anywhere on the plant for four or more consecutive weeks, this donation will be doubled for each of these weeks. When a time-lost accident occurs, the count will start anew from the morning of the following day, both for the seven day and four weeks periods."



Day shift crew of the Southwest Mine, Copper Queen Branch

The Cariboo District, British Columbia

Placer Production Estimated at $500,000 Per Year—Only a Few Drift Mines—Interest Centering in Lode Mining

By Donald D. Fraser
Quesnel, B. C.

THE production of gold in the Cariboo district of British Columbia has gradually increased from $70,000 in 1919 until 1926 should show an output of about $500,000 from the placers alone. The area centering in Barkerville has been the prime producer, with the country around Quesnel and Cariboo Lakes as second best. Additional production comes from scattered workings in Harper's Camp, along the Quesnel and Fraser rivers.

The principal production near Barkerville for the last decade has been from the hydraulic mines. This type of mining has never been carried on extensively in the Cariboo area, by reason of a lack of water. The best-equipped plant operating in this section is John Hopp's mine, on Lowhee Creek. With an extensive system of ditches and a large reservoir, this plant works continuously from the opening of spring until July, after which work is generally carried on intermittently with the aid of the reservoir. A couple of years ago a section of the head end of the flume was taken up and relaid on a lesser gradient, replacing the old wooden blocks with steel plates. This change enabled the operators to carry the flume on bedrock, which had not been possible before. Near the Catch at the foot of Devil's Canyon, Hauser Brothers have been working a small plant for a number of years with very satisfactory results, taking the water out of Burns Creek. They are working an old high run which is considered to have come from Burns Creek, Small plants are also working at 8-Mile Lake and on Cunningham Creek.

In the Devil's Canyon Nels Hanson has interested capital for draining a small lake and mining the lake bottom. An old high run crossed the canyon above the lake and it carried considerable gold. An attempt was made about fifteen years ago by some local men to do this same work, but they lost heart in the venture and the work was dropped.

Near Stanley, James Williams is drifting on Boulder Creek and in a gulch emptying into Chisholm, near town. He is also doing some work on the old Ah Quay across Lightning Creek. It is reported that a new company has been formed to hydraulic Eagle Creek, a tributary to Upper Lightning Creek.

On the other slope, which drains into Cariboo and Quesnel Lakes, the Kitchner is the only hydraulic mine of importance at present. Here an old high run is being worked which lies 100 ft. above the present creek bed. Keithley Creek water is brought to the mine through a 4-mile ditch. Apparently the plant is capable of handling about one million yards a season. Much trouble has been caused by the banks sliding into the pit, making extra work. Two years ago a magnetometric survey of the channel was made, using the Thomson-Thalen instrument. Good results were reported.

The Bullion mine, which was operated for a short time twenty five years ago, is being opened in a small way by P. Ross. The old ditches are out of repair and the flumes gone completely. By a radical readjustment of the water system, many of the old lines are omitted.

The dredge of the Kafue Copper Co., Barkerville, has been working continually, with but few shutdowns, since starting about a year ago. Operations yielded a dividend last year, which speaks well for the management as well as the ground. Recently a snag penetrated the hull and sunk the boat causing a serious loss of time. The Vancouver Dredging & Salvage Co. succeeded in floating it again.

A new type of dredge has been working on the Lower Swift River for the last two years. This dredge is of the suction type, but carrying what are claimed to be new principles, which overcome the deficiencies of the old-type suction dredge for gold mining. A large pipe, about 8 or 9 in. in diameter, extends vertically down from the bottom of the dredge. A 6-in. pipe is placed inside. Nine hundred gallons of water a minute is forced down between the two pipes and delivered through two nozzles. These two jets are used to break up the gravel, which is elevated through the 6-in. pipe. A suction pump handling 1,200 gallons a minute is used. As the gravel is mined the pipes are lowered. It is claimed that the small gravel and gold is elevated and the boulders are left behind. Until this year the company floated its machinery on a raft, but it has built a wooden hull. The ground was drilled a few years ago and the syndicate claims 5,000,000 yards assaying 40c. per yard.

The dredging ground on Williams Creek still remains unworked. This area contains several million yards assaying 25c. It has been considered that the quantity of old mining timbers that would be encountered as dredging progressed would be a serious obstacle. This ground has been drilled and check-drilled by reliable parties. Bedrock lies from 40 to 80 ft. below the surface. Of late very little interest has been shown in the unexplored sections which might make good dredging ground. There are several of those areas in the district which would justify investigation; some of the ground is held under leases and some is open for staking.

Drift mines of any note are not numerous in the district. The Cedar Creek mine, which encountered rich ground two years or so ago, is still operating, but in low-grade material.

The most interesting drift mine is the Tertiary, located near the Fraser River about twenty miles from Quesnel. The workings follow the course of an ancient channel northward from the point where it is cut by the Fraser River. This channel is, where cut by the river, 700 ft. wide and is cemented enough to make shooting necessary. The gold is heavy and fairly coarse, as the workings are in a section of the channel which had a gradient of over four per cent. As with all the channels in the schist belt, the grade will be very slight through the soft rock and will be steep over the hard strata. The soft rock and the low gradient are conducive to good gold concentration, and the paystreak is likely to be continuous. Hard rock with steep grades often produces rich pockets, but the values tend to be spotty. The present workings of the Tertiary mine are, in the main, over a hard bedrock, although short intervals of softer rock are encountered.

The only other property which might be classed as a drift mine is at Wingdam, known as the Lightning Creek Gold Gravels & Drainage Co. The company has been in existence for more than thirty years and was recently investigated by the postal authorities, showing that the management found other use for the money than underground operation.

The Quesnel River Gold & Platinum Extraction Co. has had a quiet existence for a number of years. This company holds a number of placer leases on the Quesnel River and has built a laboratory and an extraction plant near the town of Quesnel. So far it has done very little mining.

Interest Centering in Quartz Mining

As in all the placer camps, when the bonanza ground played out miners began to look for the source, and quartz prospecting started. Cariboo has been no exception to the rule. There have been a number of sporadic attempts at quartz mining, but to date none has been successful. Prosperpine Mountain, just east of Bakerville, has been the locus of most of the work in late years. The Mining Corporation of Canada in 1919 took an option on a large tract of ground there and spent considerable money on tunnel prospecting. The plans called for diamond drilling, but when the owners refused to grant an extension to substantial payments falling due, the company gave up the options. This year a Mr. Wallinger, formerly connected with the Iron Mask mine, Kamloops, B. C., has taken an option on certain claims on this mountain and is prospecting the ground through a tunnel, now advanced over 100 ft.

Considerable attention has been directed recently to the showings on Lowhee Mountain. Here a number of small stringers have been traced for some distance and show good mineralization. The upper portions of the vein are greatly decomposed and return liberal rewards when sluiced. Samples taken by the Resident Mining Engineer last year on this mountain gave results varying from 0.20 oz. to 3.06 oz. of gold to the ton. This section is particularly promising for the development of veins of concentrating ore. The mining of narrow stringers means expensive operations.

News From Washington

By PAUL WOOTON
Special Correspondent

Bureau of Mines Work Hampered by Lack of Funds—Main Objective Now to Be a Business Aid to Industry

The principal reason for transferring the U. S. Bureau of Mines to the Department of Commerce was to emphasize the business department of mining. Heretofore, the Bureau has been engaged in research and in such administrative functions as its mining safety service.

The technologic and safety activities of the Bureau are well started. They have an honorable record during their fifteen years of growth. An efficient staff is at work. In those branches, the expansion is confined largely to the expansion commensurate with the growth of the industry.

On the other hand, the work of the economic branch is in a pioneer stage. The statistical units of the Geological Survey and of the Bureau of Mines had collected reliable figures of production and of accidents, but the men in that work made no effort to keep up with the business branch of mining. The coal and minerals divisions of the Bureau of Foreign and Domestic Commerce have done some work on the foreign trade in minerals, but even that has gained no great momentum.

The present personnel of the Economics Branch consists essentially of the clerical forces of the old units which were consolidated, plus a very few men of professional grade. Three or four of these men have attained repute as engineers and geologists, but only one, C. P. White, has had responsible business experience and only Mr. White could qualify as having come recently from the ranks of the mining industry. In fact, the staff of specialists is much weaker now than when the mineral statistics were gathered by the Geological Survey. The geologists assigned to that work, though not business men, had acquired a real insight into the industries to which they were assigned. With two exceptions, these geologists were not transferred to the Bureau of Mines. In consequence, the branch needs at least six first-class men from the industries, simply to put the work back on the plane it had reached before the transfer.

The appropriations for 1926-27 are barely enough to carry the present personnel. No new work of significance can be hoped for from this staff. No progress can be made without more appropriations. Unless they can be obtained, it is quite clear that the economic work of the Bureau of Mines will do little more than continue the familiar production statistics of the Geological Survey, under a new letterhead. The subjects of consumption, distribution, markets, and stocks will remain untouched.

This seems particularly unfortunate with respect to coal, in view of the troubled days through which that industry is passing. Regardless of whether Congress passes fact-finding legislation, nearly everyone agrees that more figures are needed on coal stocks, distribution, consumption, prices, and marketing. If this appropriation can be secured, not for the coal work in particular, but for the economic branch as a whole, it will enable the Bureau to go ahead quietly without controversy on constructive work for the coal industry.

Two Engineers Added to Bureau Staff

F. A. Dalburg, of Ralston, Pa., has been placed in charge of the Bureau of Mines experiment in the mining of oil shale at Rifle, Colo. Mr. Dalburg, who is an engineer with extended experience in oil, can devote only three months to this undertaking, but his interest in seeing the work properly started has led him to take a few weeks of his time for this purpose. He was at one time mine foreman for the United Verde Extension, at Jerome, Ariz., and has served with other metal mining companies.

For six years Mr. Dalburg has been vice-president and general manager of the Standard Oil Co. of Venezuela. In addition has has had metal-mining experience in Latin America and coal-mining experience in Europe.

The mine now is ready to deliver shale to the retorts, which are to be put in operation at once.

An engineer who has had wide experience in metal mining has been added to the administrative staff of the Bureau of Mines in the person of J. H. Hedges. Until recently Mr. Hedges was general superintendent of the Prince Consolidated Mining & Smelting Co. at Pioche, Nev.

Committee to Investigate Financing of German Steel Exports

When the Treasury Department, under Section 303 of the Tariff Act, recently ruled that German steel and iron products must pay additional duties in the United States on the ground that export bounties were being paid in Germany, the German Ambassador, under instructions from his government, stated that the Treasury was in error in believing that export bounties were being paid. He asked that before this regulation was finally put into effect there should be a thorough investigation and discussion of the matter by a committee made up of two representatives of the German Government and two of the American Government. This committee will be a fact-finding body, the Germans to explain thoroughly their system of financing exports, in order that the American members of the committee may report the full situation to the Treasury for decision as to whether or not export bounties are actually being paid.

The German members of this committee are Mr. Hemmen, the reporting counsellor of legation in the foreign office, and Mr. Vogt, in the German Ministry of Economics. The American members of the committee will be William Coffin, American Consul General in Berlin, and Charles L. Turrill, assistant customs attaché in London.

Mining Corporation Adds to Holdings

THE Mining Corporation of Canada, Toronto, Ont., has acquired extensive holdings in the South Lorrain silver area of northern Ontario. Buildings are now being erected on claims situated more than a half a mile south of the Nipissing group. It is proposed to sink a shaft as far as the contact, which will be explored thoroughly. The geology of these claims presents similar features to the formation of the most productive areas of the Cobalt camp.

Wade Mine Purchased by Cleveland-Cliffs at Court Sale

A report was filed in the district court at Duluth, Minn., on July 29, by Sheriff Magee, of St. Louis County, stating that the Wade mine, near Kinney, Minn., has been sold to the Cleveland-Cliffs Iron Co. following a foreclosure for $64,121,53. This foreclosure and sale was the result of a judgment for $63,375,90 entered in the district court on May 12 by the above-named company against the Struthers Furnace Co. These two companies jointly leased the mine on Oct. 13, 1918, but when the Struthers company went into the hands of a receiver on Jan. 15, 1925, a damage action was instituted in the district court by the Cleveland-Cliffs company, for a total of one-half of the expenditures made by the Cleveland-Cliffs for the protection of the property and continuance of the mining lease. The Cleveland-Cliffs company now owns the lease on the property.

Calumet & Hecla Seeks Additional Miners

The Calumet & Hecla company, Calumet, Mich., is advertising in the iron district for underground workers, stating that "the copper situation now justifies the reopening of more shafts and making places for all classes of underground men." Three hundred men are wanted at once. In June, the average pay of experienced miners was over $5 per eight-hour shift, some making over $7; loaders received an average of $4.50 per shift, many earning $5 to $6. Company houses rent for $5 to $9 per month and, if desired, company medical and hospital service is provided for employees and dependents. Group life insurance and sick benefits are additional features.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Smelter for Flin Flon Assured—Reduced Power Rates for Kirkland Lake

The H. P. Whitney interests, who have an option on the Flin Flon mine, in northern Manitoba, have officially announced that they will build a pilot smelter on the property. This will entail an expenditure of approximately $750,000. The new smelter will be the only one between the Horne smelter, in Quebec, and British Columbia. Large orders have already been placed for explosives and supplies and arrangements are being made for a supply of wood for fuel. No official announcement has as yet been made regarding the option, but as a final answer is called for within the next two months or so, it may be taken for granted, in view of the proposed expenditures, that the option will be exercized. It is understood that within the next month official assurance will be given to the Manitoba Government regarding the option, so that arrangements may be made for the construction of a railroad, which is essential to the operation of the property.

The Canada Northern Power Corporation announces that it will build a transmission line from Indian Chutes to Kirkland Lake, a distance of between 30 and 40 miles. The Indian Chutes plant was built by the Great Northern Power Co. and can develop approximately 4,000 hp. The power company apparently recognizes the dissatisfaction existing in the Kirkland district, not only with regard to the price for power, but also with the quality of the service provided, and steps are being taken to remedy this situation. Since the Canada Northern Power Corporation acquired the Northern Ontario Light & Power Co., consolidation of the power services in operation by different companies has been in progress. David Allen, formerly manager of the Northern Ontario Light & Power Co., has been appointed general manager. It is announced that N. A. Timmins, president of the Hollinger company, is joining the board of directors of the power corporation.

The annual report of the McIntyre mines, of Porcupine, for the year ended June 30, will show, according to belief, a gross revenue of $3,804,744, an increase of $258,137. Costs, including development, amount to $2,121,322, leaving operating earnings of $1,683,452. After making allowance for non-operating revenues and deducting taxes, estimated at $166,514, net earnings before depreciation will be shown at $1,721,382, an increase over the previous year of $102,496. This should leave the company with approximately $2,800,000 cash on hand, which will be ample to carry out the large program of development now planned.

Announcement is officially made that at the Foley mine, at Mine Centre, western Ontario, a crosscut at the 850 level has intersected the Jumbo vein, where it shows 16 ft. of $10 ore. The company did not expect to obtain these values at this particular point, as it is not underneath the ore on the upper levels. The British Canadian Mines, which controls the Foley, also has the Cobalt Contact property, in Cobalt. This mill recently started operations and is treating 30- to 40-oz. ore. A new flotation plant is being installed, and it is expected that arrangements will be made for the installation of a tube mill to permit of finer grinding.

The La Rose mines, of Cobalt, has curtailed operations pending a financial reorganization. The company still has possibilities at its Cobalt properties and also owns claims in the Quebec district, where some exploration work will be done this summer.

Kirkland Lake Developments

At the Barry-Hollinger property, in the Kirkland section, it is announced that on a crosscut on the 800 level an entirely new orebody has been found. Officials state that this is the best ore so far discovered on the property.

The Kirkland Lake Gold has stopped drifting and is again sinking, and will open up two new levels at 2,350 and 2,475 ft. It is announced that the mill will be in operation some time in September.

The Wright-Hargreaves has just completed its main shaft to the 1,250 level, and is now connecting the north shaft with a winze from the 700 to the 1,250 level. Developments on the main vein at the 1,250 level are much better than on the 1,000 level. The mill is treating about 430 tons a day, and there is no immediate prospect of any increase.

It is understood that the Lake Shore will sink its main shaft from the 1,000 to the 1,250 level, and the Teck-Hughes shaft will also be deepened to about 1,750 ft. Diamond drilling below the 13th level has given excellent results, which are understood to be sufficient to justify the management in going ahead with its plans for a new mill.

The Sylvanite has definitely announced its intention to build a new mill and the Tough-Oakes mill has recently been enlarged to 175 tons a day. Developments at the lower level are satisfactory, and the outlook for this property has been considerably improved.

The Lucky Tiger mines, with head offices in Kansas City, has recently taken options on several groups of claims in Duprat, Montbray, and Dasserat townships in the northwestern section of Quebec. This company had an option on the Pawnee property, in Kirkland, on which some work was done, but the option was allowed to lapse.

Plutus Mining Co. Ends Year's Work with Surplus

The Plutus Mining Co., Eureka, Utah, 90 per cent of which is owned by the Chief Consolidated Mining Co., reports that on May 31, 1926, it had $294,950 in its treasury. Discovery of extensive orebodies enabled the company to pay off $90,145 of indebtedness during 1925 and to complete the year with $217,427. During the first five months of the current year, a net of $167,668.64 was earned. On July 15, the company paid its first dividend of 15c. a share.

Johannesburg Letter

By John Watson

Special Correspondent

Rand Mines Yield Good Profit on Lowest Grade of Ore—Lydenburg Platinum Mill Started

Johannesburg, June 29—The Chamber of Mines on June 23 issued a monthly statement, which shows that the output of gold for May was a record. It also says that working costs fell to 18s. 6d. per ton of ore milled, which is a reduction of 10d. per ton compared with the previous month and the lowest figure attained for ten years. Only one Rand gold mine (Luipaardo Vlei) showed a loss—3d. per ton milled. The average profit for the Witwatersrand was 8s. 9d. per ton milled and the total profit was £1,119,510, which was the largest during the last eighteen months, though the average grade of ore milled was only 6.38 dwt. per ton—the lowest throughout this period. C. E. Mason, the chief engineer of the Rand Water Board, recently interviewed by a *Star* correspondent, gives some interesting figures, which show that the gold mines of the Witwatersrand in 1925 took 1,889,897,395 gal. of water. Twenty years ago they took only 96,768,860 gal. Transvaal Platinum, Ltd., reports that its reduction plant milled 1,055 tons during May. The crude platinum produced is estimated to contain 123 oz. of platinum and allied metals. Recovery per ton has increased to nearly 2½ dwt., owing to improved grade of ore milled. During the first six weeks' operations, the recovery was 1½ dwt. to the ton, low-grade ore being purposely used in starting up the new plant. The furnace portion of the plant should be completed within about two months, when it is hoped the percentage of extraction will be improved to some extent.

Rand Dividends, 1926

The following dividends of South African mining and manufacturing companies have been declared for the half year ending June 30. Last year's dividends are given for comparison:

	June, 1926, Per Cent	June, 1925, Per Cent	Dec., 1925, Per Cent
Aurora West	.....	10	.....
Brakpan	25	22½	25
City Deep	10	15	15
Consolidated Main Reef	3¾	2½	2½
Crown Mines	30	30	30
Geduld	17½	16½	18¾
Government G. M. Areas	32½	32½	32½
Langlaagte Estate	5	2½	2½
Meyer and Charlton	25	35	35
M dder B	40	40	35
Modder Deep	65	65	70
New Modder	55	60	55
New State Areas	7½	7½	7½
Robinson Deep A (per share)	1s. 6d.	1s. 6d.	1s. 6d.
	Per Cent	Per Cent	Per Cent
Robinson Deep B	3½	7½	7½
Rose Deep	3¾	7½	5
Springs	16½	15	16½
Sub-Nigel	7½	3¾	5
Van Ryn G. M. Estate	2½	7½	5
Van Ryn Deep	22½	27½	22½
Village Deep	.....	2½	2½
West Springs	5	.....	7½
Witwatersrand	2½	5	.....
Witwatersrand Deep	12½	8¾	10

A Kimberley correspondent reported, on June 15, that a 44-carat diamond had

been found at Windsorton, on the Vaal River, by Seymour Windsor and sold for £55 a carat. This total (£2,420) is believed to be a record price since that obtained for the Boon diamond. The Lydenburg Platinum Areas, Ltd., announce that a preliminary trial run of the pilot plant at Dwars River was started on June 1. It is hoped to effect any initial necessary adjustments by July. On the Johannesburg Stock Exchange during the last week the market has been very active. Gold shares are mostly higher. Sub-Nigels were dealt in daily to a large extent, and their price has risen during the week from 39s. 6d. to 47s. 6d. T. C. Lands have been quiet throughout the week at about 53s. Potgietersrust platinums have risen from 8s. 8d. to 9s. 8d. with large business. Lydenburg Platinum Areas have improved during the week from 7s. 3d. to 9s. 1½d.

Mono Mills 22 Oz. Silver Ore

The Mono Mining Co., operating a silver mine near Sweetwater, Nev., but about two miles across the state line in California, is milling 65 tons of 22 oz. silver ore per day. Recent mine developments are reported to be very satisfactory. The 100 level north drift from the winze from the lower tunnel has been in ore for over 60 ft., and the face of the drift shows 11 ft. of 52 oz. ore. The oreshoot on the lower tunnel was the most important ever developed in the history of the mine, and deeper developments give promise of a greater width of vein and improved values. Present mill tonnage is coming partly from development at various points and partly from stoping on upper levels.

Alderson and MacKay Developing Ore at Rouyn

Diamond drilling on the property of Alderson and MacKay, in Boischatel Township, in the Rouyn district of Quebec, has revealed a large deposit of chalcopyrite. Of the last three holes put down on No. 4 orebody the lower hole cut 38 ft. of massive chalcopyrite and pyrrhotite at a depth of 300 ft. below the surface. The center hole cut through 56 ft. of massive ore, and the top hole cut through 37 ft. of ore. No. 4 orebody was found with a dip needle. The readings indicate that the body is large and extends a long distance to the east.

Elsie K Mine Shipping Good Ore

Major A. H. Wilson, one of the two owners of the Elsie K., at Clarksfork, Idaho, reports that seven carloads of ore have been shipped to Tacoma and that the property has been closed down to permit putting in a concrete base under the engine and the installation of electric lights. He expects to resume work about Aug. 20 with three shifts. He says that enough ore has been blocked out to run two years. The ore is lead and silver without zinc. Three tunnels on practically the same level have been run a quarter of a mile apart and connected by drifts. The shipments have netted $3,000 to $5,000 to the car.

London Letter

By W. A. Doman
Special Correspondent

Discovery of Important Tin Deposits in Burma—Katanga Reports 76,890,000 Tons Ore Reserves

London, July 21—The tin position is becoming interesting again. For a time the price of the metal receded, due, according to experts, to a seasonal decline in orders. It is now on the upgrade again, and stands at £285 2s. 6d. per ton. Several flotations have been made recently, and rumor says that the autumn is to witness a still higher price level. In this connection may be mentioned a cabled message from Rangoon that Dr. Morrow Campbell, geologist, has discovered vast amounts of tin-bearing detritus in the shoals along the Mergui coast, in Burma. It is readily accessible, he says, and valuable dredging ground may exist. New discoveries and increased output would, in the ordinary course, reduce the price of the metal. The annual report of the Union Minière du Haut-Katanga states that the Busanga mine produced last year 854 tons of cassiterite, which was refined in Belgium.

As pointed out last week, the proposed copper-selling organization has created a good deal of interest over here. No reference was made to the matter at the annual meeting of the Union Minière, but the directors' report—a copy of which has just reached London—contains the following paragraph: "With a view to improving the selling conditions in Europe, our company has recently participated in the creation of an organization, embodying about 90 per cent of the world's copper producers, the object of which is to facilitate direct transactions between producer and consumer." Nothing further is said, but a report emanating from Brussels is to the effect that a suggestion has been made to ship copper to America. Interested people here do not care to make any comment on the matter, so that presumably the negotiations are not yet completed. The idea, however, seems to be to eliminate the middle man, as he has not always played the game, or given the producing companies a square deal. This seems to be a legitimate reason for creating a pool or an organization. A trust, however, even supposing it were legal, would stand little chance of success.

The Union Minière report shows that although 90,104 tons of copper were produced last year, the reserves were added to, for the total of oxide and sulphide ores at Dec. 31 last was 76,892,943 tons averaging 6.87 per cent copper, or a total content of 5,285,640 tons of metal, compared with 74,686,600 tons of ore averaging 6.69 per cent and containing 4,998,000 tons of copper, for the previous year. The need to include the Katanga undertaking in any selling scheme is apparent. The company is suffering from labor trouble, and every effort is being made to improve and increase mechanical methods of production.

The National Smelting Co., in conjunction with the Burma Corporation and the Australian Broken Hill group, is testing at Avonmouth a new metallurgical process "which promises to become important." Details have not yet been made public.

Austrian Iron and Steel Production Falls Off

The largest company making steel in Austria, the Alpine Montangesellschaft, controlling about 70 per cent of the country's output, reports the pig-iron production during June was 24,000 metric tons, only 5,000 tons below the figure for May, according to the U. S. Department of Commerce.

Production of steel ingots in June was 30,000 tons, which exactly equaled the company's unfilled orders at the end of that month. Preparatory to the consolidation of Austrian and Czechoslovakian industrial cartels with those of France and Germany, the present Czechoslovak cartel agreement has been denounced by Austria, and the Alpine Montangesellschaft is liquidating its coke holdings in Bismarkschuette and Czechoslovakia.

Paymaster Crown Grants Valid

The Judicial Committee of the Privy Council, in England, has allowed the appeal of the Province of Ontario and others against the McLean Gold Mines, Ltd. The decision confirms the right to mining lands to the Premier Paymaster Mines, operating near South Porcupine, Ont., which the Appeal Court vested in McLean Gold Mines, Ltd. McLean brought action against Paymaster, and lost the case. Decision was reversed in the Appellate Court, which gave the title to McLean. The Privy Council decision restores the lands in question to Paymaster.

The decision is an important one, as the whole question of the validity of Crown grants was involved. Decision in favor of Paymaster confirms this validity and will remove much uneasiness which was occasioned by the Appeal Court decision.

C. & A. Sinks Shaft at Mineral Park

At Mineral Park, Ariz., the shaft being sunk by the Calumet & Arizona Mining Co. has reached a depth of 180 ft., and is said to be entirely in ore. Crosscutting is to be started at the 200 or 300 level, according to H. A. Clark, general manager of the C. & A., who was a recent visitor at the property.

Air Blast in Quincy Mine Entombs Miner

An air blast in the 75th level of No. 6 shaft of the Quincy mine, at Hancock, Mich., on July 28, entombed one miner, eight other men making their way to surface by climbing 7,500 ft. up No. 8 shaft. The blast, which occurred about 2 500 ft. north of No. 6, partially caved the level, but the shaft itself is intact, and operations generally will not be delayed. The blast was the only severe one in No. 6 for many months.

People You Should Know About

Carl O. Lindberg, of Los Angeles, is in New York.

George H. Garrey is on a trip to the Cobalt and Gowganda districts, in Ontario.

P. N. Moore, of St. Louis, is in Denver, Colo., on personal and professional matters.

Gail F. Moulton, of the Illinois Geological Survey, is making a study of the Centralia oil fields.

A. Homer Black, mining engineer of Tonopah, Nev., has gone to New York on an extended trip.

Charles D. Kaeding, of San Francisco, has been in the vicinity of Tonopah, Nev., on professional work.

J. H. Coghill has been appointed mining recorder of the Elk Lake mining division of northern Ontario.

Maurice Leehey, a prominent mining lawyer of Seattle, is in the interior of Alaska on professional work.

R. G. Thornburg, of the U. S. Bureau of Mines, is in charge of first aid and mine rescue training in Alaska.

Arthur W. Stevens, mining engineer, resigned his position as superintendent for the Idaho Copper Co. some time ago.

Professor J. Volney Lewis, of Rutgers University, is in California for six or eight weeks on professional business.

Nelson Dickerman, mining engineer, of San Francisco, has joined the engineering staff of the Yuba Manufacturing Co.

H. A. Wheeler, of St. Louis, has returned from California, where he examined gold properties in the Mother Lode district.

H. A. Johnson, superintendent for the Tonopah Mining Co. at Tonopah, Nev., has returned to Tonopah from Southern California points.

P. W. Racey, superintendent for the Tonopah Belmont Development Co., in Nevada, has returned to Tonopah from a business trip to San Francisco.

Roy K. Brown, until recently mine superintendent for the Tonopah Belmont Development Co., at Tonopah, Nev., has removed to San Francisco.

John D. Ryan, of New York, chairman of the board of directors of the Anaconda Copper Mining Co., is visiting at Houghton, Mich., enjoying a brief rest.

L. S. Cates, vice-president and general manager of the Utah Copper Co., accompanied by his daughter, Barbara, is making a two months' tour of Europe.

A. G. Mackenzie, secretary of the Utah Chapter of the American Mining Congress, has returned to Salt Lake after his semi-annual visit to inspect Tintic operations at Eureka, Utah.

Walter Fitch, Sr., president of the Chief Consolidated Mining Co., has returned to his headquarters in Eureka and Salt Lake thoroughly rested after a four months' trip to Europe.

Mrs. Mabelle Mars, of Duluth, Minn., is the first woman prospector to stake out mining claims in Ontario. She has been prospecting in the Red Lake area for some time, and has staked out nine claims.

Dr. William Cullen, formerly manager of the Modderfontein dynamite factory, has been in the Transvaal for about three months, after an absence of about nine years.

Sherwin F. Kelly, who had, during the school year just closed, been acting as demonstrator in mineralogy at the

Sherwin F. Kelly

University of Toronto, and who has also been conducting research on the microstructure of anthracite and anthraxolite and on the application of color photography to mineralogy and petrography, is now engaged in field work in prospecting with the Schlumberger method, by direction of the Ontario Department of Mines, in the South Lorrain and Red Lake districts of northern Ontario.

A. M. Gilliespie, Arizona mining operator, has spent several weeks in Salt Lake City, Utah, arranging for the sale of control of the Arizona Hillside Mining Co. to Chester R. Bunker, of Fort Worth, Tex.

J. J. O'Neill, of Montreal, was suddenly taken ill with appendicitis while examining the Hewitt mine, at Silverton, B. C. He was taken to Kaslo by special train, and was operated upon in the hospital there.

Charles Marx, general manager of the Government Gold Mining Areas, expected to leave South Africa for England last spring, but owing to a serious relapse will not be able to travel for some weeks. Mrs. Marx recently sailed from Southhampton to accompany her husband on his voyage to the homeland.

Gerald R. Simpson, general manager of the Simpson Engineering Co., of Long Beach, Calif., recently returned from a trip to San Xavier, Sonora, Mexico, on engineering work in connection with the erection of a flotation mill to treat a dump of lead-silver tailings. Mr. Simpson visited Tombstone, Fort Huachuca, and Tucson en route.

A. N. Welton, mining engineer, has resigned his position with the Gold Feather Mining Co., at Deadwood, S. D., and has accepted a place with J. H. Estos & Co., of Boston, as that company's engineer to open up and develop the property of the Unity Mines Corporation at Wenden, Ariz. This company has made extensive plans for buildings and a mill after development. The property was examined by Mr. Welton for four weeks. It consists of nearly five hundred acres situated in the Harcuvar Mountains six miles from Wenden. Mr. Welton recently left for Arizona.

Dr. Willard R. Jillson, State Geologist of Kentucky, and Mrs. Jillson have just returned to the United States from Europe and Canada. Their itinerary covered seventeen countries. A good part of the trip was made by airplane. Dr. Jillson attended the Fourteenth International Geological Congress, under official appointment of Governor W. J. Fields, to represent Kentucky, the Kentucky Geological Survey, and the Kentucky Academy of Science. He delivered a paper before the Congress entitled "Oil Shales of the United States." Dr. Jillson also made investigations of petroleum, coal, and fluorspar deposits of Europe.

W. Val de Camp, general superintendent of the United Verde Copper Co., suffered a painful accident recently when he was inspecting the loading bins on the 900 level of the mine. Much calcined ore from the steam shovel pit is being passed through the big loading raise of the mine, and as Mr. De Camp was inspecting the bins with a view to protection against the fine dust he was enveloped in a cloud of the sulphur-charged "fines," which burned his eyes severely. The burns were not from hot dust, as was at first reported, but were occasioned by the sulphur content. He was taken to the United Verde hospital, and later removed to his home. His eyes have now recovered sufficiently to allow him to return to his duties, although complete recovery will take a while longer.

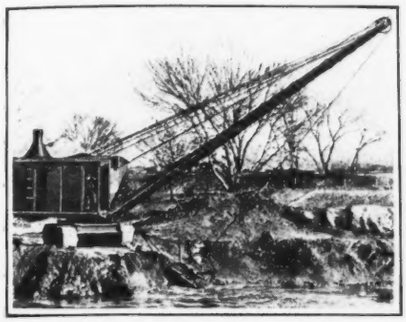
Obituary

Samuel Isaac Lilley, a pioneer prospector of South Africa, died recently at Krugersdorp, in the Transvaal, at the advanced age of eighty-four. He discovered at Pilgrims Rest, in December, 1874, a nugget of gold of 119 oz. 2 dwt. This nugget was named "Perseverance," and it was of a shape resembling the head of a Newfoundland dog. In the same claim, in July, 1875, he discovered another nugget of 213 oz. weight which he and his partner named "Reserve."

New Machinery and Inventions

New Shovel Introduced

The 41-B, a 1¼-yd. shovel, has recently been announced by the Bucyrus Co., of South Milwaukee, Wis. It has been built primarily for those jobs of excavation where capacity greater than that offered by a 1-yd. dipper is needed.



Shovel is easily converted to dragline

The shovel, which has a two-part hoist, is quickly and easily convertible to a dragline. It is designed so that the drum speed is the same for dragline or shovel work. Therefore all that is necessary to convert the shovel to a dragline is to add the drag drum, change the booms and cables, and add the fairlead. The drag drum is mounted well back on the shovel, giving the desirable long lead from the fairlead to the drum. As a dragline the machine is offered with a 40-ft. boom and a 1-yd. bucket or a 45-ft. boom with a ¾-yd. bucket. Except for the larger capacities and working ranges, making correspondingly heavier working parts, the new shovel is a companion to the Bucyrus 31-B, the 1-yd. machine recently announced by this company.

The machine has a box girder boom, outside dipper handles, a two-part hoist working over a large diameter sheave, cast base and revolving frame, and caterpillars employing larger diameter roller and tumblers. It takes its place midway between the 31-B 1-yd. shovel, and the 50-B, a 1¾-yd. shovel.

The company now offers caterpillar-mounted revolving shovels in three classes: small revolving shovels, mine and quarry and general utility large revolving shovels, and stripping shovels, with dipper capacities ranging from ¾ yd. to 8 yd. The Bucyrus draglines range in size from ½ yd. to 8 cu.yd.

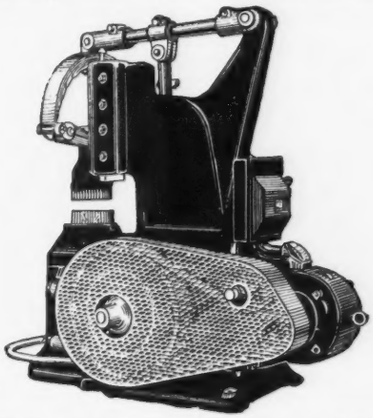
New Power Hammer Sensitive—Of Great Forging Capacity

A neat and compact power hammer is being made by the Central Machine Works, of Minneapolis, Minn. It takes up little space, its floor dimensions being 3 ft. by 4 ft. 2 in., and it is only 5 ft. high. Though the weight of its ram is 100 lb., it requires approximately only 2½ hp. to operate it at its maximum speed of 230 r.p.m.

Power is transmitted through a sensitive control by positive friction clutch mounted in the solid web drive pulley. Through the foot pedal extending around the hammer the operator controls the clutch, making it easy for him to secure any kind of a blow he desires, according to the manufacturers. The action of the clutch is sensitive and positive and it responds instantly to the slightest touch of the foot, so that any blow from a gentle tap to the heaviest can be had instantly at any part of the forging. This positive control of the blow makes it possible to easily forge anything from a small pin to a heavy 4-in. or even 5-in. billet. There is also ample space to weld a 3-ft. tire.

Lubrication of the crank shaft and pulley bearings is provided for through the hollow crank shaft with oil fed from ample reservoirs on both sides of the hammer.

A feature of the hammer is the method of suspending the head, which gives the hammer much greater forging capacity than other hammers of the same weight. From a six-leaf steel spring, the hammer is suspended by ten plys of leather, giving the head a quiet and elastic travel. On small forgings, where the lighter blows are used, the head's travel affects the spring but little. On the heavier blows, however, where a longer travel of the ram and a snappier punch is desired, the steel spring is contracted until the ram reaches its maximum height of travel. At that point there is considerable tension on the spring and as it expands it snaps the head downward with a terrific blow. As the hammer strikes the resiliency of the mounting gives the head a quick elastic rebound.



Great forging capacity is secured for this power hammer by the manner of suspending the head

The forging capacity of the hammer is greatly increased by its quick adjustment features, so that the proper blow can be secured for the smallest as well as largest piece. A milled pinion is mounted within easy reach at the top of the connecting rod, by means of which the ram is quickly raised or lowered to change the distance between the dies. The stroke of the ram is also just as quickly changed.

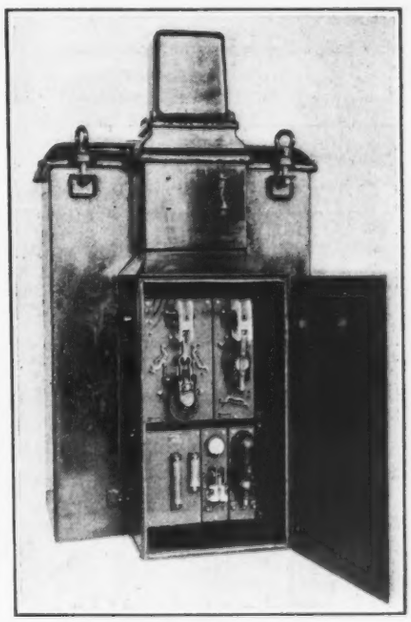
The hammer can be furnished in either belt or direct-connected motor drive. On the latter, the motor and safety switch are both mounted on the rear of the hammer with an approved safety guard covering the belt and pulleys.

Starting Equipment Controls Motors Automatically

For controlling 2,300-volt synchronous motors a completely self-contained, oil-immersed automatic starter has been developed by the Electric Controller & Mfg. Co., of Cleveland, Ohio. This device, as shown in the accompanying illustration, is built for across-the-line starting of slow-speed motors and for reduced-voltage starting of higher speed machines. The illustration shows a reduced voltage starter, but the full-voltage equipment for the slow-speed motors is of similar appearance except that the height of the installation is less.

In either case the operator simply pushes a button to start the machine and as the motor approaches synchronous speed, the field excitation is automatically applied. The reduced-voltage starter consists of a welded boiler-plate tank containing an automatic double-throw switching mechanism, a power transformer for providing starting voltage, and potential transformers giving 220 volts for the master-switch operating current and the current-limit transition relay, which connects the motor to full voltage when it has been accelerated to the point where it has approximately 85 per cent of synchronous speed.

Outside the tank a dustproof steel cabinet is provided. This encloses a field-switching mechanism, field-discharge resistor, timing relay and direct-current field ammeter. This cabinet also contains an automatic starter for operating a magnetic clutch. The full-voltage starter is of similar construction except that the starting auto-transformers are omitted. The equipment is complete in a single unit, making it possible to mount on the floor all the mechanism necessary for starting synchronous motors.



Complete Starting Equipment

This tank with its attached cabinet contains all the mechanism necessary for starting a synchronous motor and putting it on the line. No switchboard equipment is required when this starter is installed.

The Market Report

Copper, Lead and Tin Prices Advance Further

New York, Aug. 4, 1926. — Copper, lead, and tin prices all registered substantial advances in the week ending today, and are decidedly firm at the higher levels. The volume of copper sales dropped considerably, but there was an active inquiry for lead and tin. Silver declined ¾c. an ounce owing to lack of Indian buying, and zinc is slightly weaker. Domestic industrial conditions promise to continue excellent over the remainder of the year, so the stock market has recently been buoyant, and the metal markets are also favorably affected.

Copper Firm at 14½c.

Copper has continued on its march toward the 15c. level, though the advance has been orderly and well justified by the unusually great demand. On Thursday and Friday selling was general at the 14⅜c. level in the East and 14½c. in the Middle West, and a little was still obtainable at these levels on Saturday. On Monday most sellers advanced their prices ⅝c., though a fair tonnage was sold at 14.425c., and on Tuesday at 14.475c. for Eastern deliveries. Today every seller seems firm at 14½c. in the East and 14⅝c. in the West, though there is little interest on the part of consumers. The total volume of sales for the week has been about 60 per cent of last week, but sellers are well satisfied, as they have little copper for August or September delivery to offer. One interest did close to half of the week's business. Unprecedented bookings are reported by firms making copper products, such as sheets, wire, and tubes; the automobile demand has been excellent, and newer outlets, such as washing and refrigerating machines, have required much more copper than was expected.

The foreign market has been quiet, American agencies now quoting 14.65c., c.i.f., without caring much whether they get orders or not.

Lead Nears 9c.

Another advance was made in the contract price of lead by the American Smelting & Refining Co. on Friday, when 8.90c. was established as the New York level, instead of 8.75c. Other sellers lost no time in following the Smelting company's lead. Some few sales have been made at slight premiums, as high as 9.15c. having been paid, New York basis, where spe-

Daily Prices of Metals

July Aug.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
29	14.15	63.375	64.25	8.775	8.60@8.75	7.45
30	14.15	63.50	64.25	8.90	8.70@8.75	7.425
31	14.15	63.50	64.25	8.90	8.75	7.40
2	14.20	63.375	64.25	8.95	8.75@8.85	7.375@7.425
3	14.25	64.25	65.00	8.925	8.75@8.85	7.375@7.40
4	14.275	64.375	65.375	8.925	8.75@8.85	7.375@7.425
Av.	14.196	63.729	64.563	8.896	8.758	7.410

The prices correspond to the following quotations for copper delivered: July 29th, 30th and 31st, 14.40c.; August 2d, 14.45c.; 3d, 14.50c.; 4th, 14.525c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

July Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
29	58⅞	59⅝	67	291½	286¼	33	32 9/16	34⅜	34 11/16
30	59	59¾	67	291⅝	286½	33¼	32 13/16	34	34 9/16
2	Holiday	...	...	....	....	....	....	....	....
3	59¼	60	67¼	294½	288¼	33 3/16	32⅞	33 15/16	34 9/16
4	59¼	60⅛	67¼	296¼	289¼	33⅛	32 11/16	34	34½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver		Gold London	Aug.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
29	4.85 5/8	64⅛	29 9/16	84s11d	2	4.85 5/8	63⅜	Holiday	Holiday
30	4.85 5/8	63 7/8	29 7/16	84s11½d	3	4.85 5/8	63¼	29 3/16	84s10½d
31	4.85½	63⅝	29⅜		4	4.85¾	63⅜	29¼	84s9¾d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for July, 1926

Copper:	
New York Electrolytic	13.924
London Standard Spot	57.864
London Electrolytic Spot	65.625
Lead:	
New York	8.499
St. Louis	8.383
London Spot	31.716
London Forward	31.545
Silver:	
New York	64.793
London	29.861
Sterling exchange	485.755
Zinc:	
St. Louis	7.411
London Spot	34.045
London Forward	34.270
Tin:	
99 per cent	61.365
Straits	63.091
London	282.102
Quicksilver	90.163
Antimony	14.490
Platinum:	
Refined	114.692
Crude	109.000
Aluminum, 98 per cent	27.000

cial brands were desired, or by consumers not in good standing with some of the producers. Inquiries have been heavy throughout the week, for both August and September shipment. One large seller released lead more freely than he has recently, so the total volume of business was somewhat larger than usual. Consumption seems to be good in practically every line.

In the Middle West, dealers have been asking about 8.90c., St. Louis, in the last few days, though one producer has sold at 8.75c., and another at 8.80 and 8.85c.

Corroding grades of lead command the customary premium of $2@$3 per ton.

Zinc Prices Shaded

A fairly good volume of zinc orders was booked in the week ending today, though galvanizers are in general buying only in small lots, and for early delivery. There is no chance of export at current London prices, and with a somewhat higher production with $50 ore in the Tri-State district, it is difficult to keep prices firm. Sales were reported at 7⅜c. today. Small lots have commanded slight premiums in some instances, as high as 7½c. having been done early in the week. New York prices on Prime Western continue at 35c. per 100 lb. above those at St. Louis, and "high-grade" zinc is unchanged at 9c. per lb. delivered in the East.

Tin Buying Improves

The diminution in world stocks of visible tin was somewhat greater than was generally expected, being slightly over 2,000 long tons for the month of July, and the stocks at the end of that month being at the low level of 13,777 long tons, in spite of Straits shipments of 6,774 long tons. Dealers and consumers were active purchasers on Monday and Tuesday, the consuming demand being largely for prompt delivery. Today has been quiet, but prices have advanced a little more, to 65⅜c. for prompt Straits. Futures are from ½ to 1c. cheaper.

Francs Recover Further

Closing cable quotations on Tuesday, Aug. 3, were: francs, 2.74c.; lire, 3.33c.; and marks, 23.81c. Canadian dollars, $\frac{9}{64}$ per cent premium.

Silver Lower—Royal Commission on Indian Currency Reports

India has refrained from dealing in silver during the last week, which left the market very narrow and in the hands of China. Fluctuations have been small, although London again touched the low price for the year at 29 $\frac{3}{16}$d., previously established on April 22. The chief item of interest was the publication in London on Aug. 3 of the report by the Royal Commission of Indian Currency and Exchange. This report recommends the stabilization of the rupee at 1s. 6d. and the establishment of a reserve bank to manage currency on the basis of buying and selling gold bullion. It further proposes that the rupee shall be legal tender only up to the amount of 50 rupees, and that the silver holdings in the reserve shall be gradually reduced during the next ten years, apparently by sale, if such silver does not go into circulation.

Mexican Dollars (Old Mexican pesos): July 29th, 48⅜c.; 30th, 48¼c.; 31st, 48⅜c.; Aug. 2d and 3d, 48¼c.; 4th, 48⅜c.

Steel Prices Firm—Pig Iron Quiet—Coke Dull

Pittsburgh, Aug. 3, 1926

Steel production in July was at approximately the same average rate as in June, when production was at 80 per cent of assumed capacity. The absence of the familiar decrease is noteworthy, while a distinct upturn, such as frequently occurs in August, is correspondingly less likely.

Steel consumption continues to run very heavy, and prospects of many consuming industries are considered better than two months ago.

Steel prices are steady all along the line, showing no discernible stiffening or weakenings.

Pig Iron—Valley foundry iron is off 25c., at $17.50, bessemer remaining at $18.50 and basic at $17.50. The market stays very quiet.

Connellsville Coke—The market remains dull. Spot furnace, $2.85@$3; spot foundry, $4@$4.50.

Lead Ore Again Advanced—Zinc Blende Unchanged

Joplin, Mo., July 31, 1926

Zinc Blende	Ton
Premium blende, basis 60 per cent zinc	$51.00@ 52.00
Prime Western, basis 60 per cent zinc	50.00
Fines and slimes, 60 per cent zinc	49.00@ 46.00
Average settling price, all zinc	48.23
Galena	
High	114.20
Basis 80 per cent lead	112.50
Average settling price, all lead	107.47

Shipments for the week: Blende, 14,879; lead, 2,078 tons. Value all ores the week, $942,070.

Shipments for seven months: Blende, 485,626; calamine, 261; lead, 71,187. Value, all ores thirty-one weeks, $31,652,590—more than a million dollars per week.

Sales today aggregated 16,490 tons, and practically represents the production of the week, as only current production was for sale. There are but a few mills at which outputting has not been resumed either on part time or full time, with about seventeen running overtime—milling on night shifts. Flotation units are now adding approximately 1,500 tons per week to the output.

Lead production continues steady, around 2,100 tons per week.

Platteville, Wis., July 31, 1926

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$52.75
Lead Ore	
Lead, basis 80 per cent lead	$110.00

Shipments for the week: Blende, 1,248 tons; lead, none. Shipments for the year: Blende, 31,467; lead, 752 tons. Shipments for the week to separating plants, 2,598 tons blende.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—Per lb., 99 per cent, 27@28c.; 98 per cent, 27c. London, 98 per cent, £118 per long ton. Domestic demand good.

Antimony—Per lb., duty paid: Chinese brands, spot, 15¾@16c., with futures about ¼c. cheaper. Cookson's "C" grade, spot, 18@18¼c. Consumers in United States buying lightly for immediate requirements only. Stocks probably sufficient to avert a shortage in the fall, however. Floods causing some interference with Chinese shipments.

Chinese needle, lump, 12c. Standard powdered needle, 200 mesh, 13c. White oxide, Chinese, 99 per cent Sb_2O_3, 15c. Nominal; little business.

Bismuth—Per lb., in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per lb., 60c. London, 1s. 10½d. for American metal; 1s. 9d. for Australian metal.

Cobalt—F.o.b. Canadian works, per lb., shot, 96@98 per cent, $3. Black oxide, 70 per cent, $2.10@$2.20. London, 10s. for metal; 8s. for black oxide; 8s. 9d. for gray.

[1]**Germanium Oxide**—Per gram in 25 to 50 gm. lots, $6.

Iridium—Per oz., $125@$135 for 98@99 per cent. Nominal. London, £63@£65 in iridio-platinum; £50@£55 for sponge and powder.

[1]**Lithium**—Per lb., 95@96 per cent grade in 1 to 5 lb. lots, $65.

Magnesium—Per lb., in ton lots, ingot, 75@80c. depending on quality; best 99.8 per cent. Market unchanged. London, 3s. 9d.@4s. 3d. for 99 per cent ingots or sticks.

[1]**Molybdenum**—Per kilogram, 99 per cent, $25; C. P. metal, $80.

Monel Metal — Base price for shot, 32c. per pound.

Nickel—Per pound, ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). Market active with good demand. London, £170@£175 per long ton according to quantity.

Osmium—Per ounce, $65@$75; London, £17@£20.

Palladium—Per oz., $69@$71. As a constituent of crude platinum, $60@$65 per oz. London, £12@£15, nominal.

Platinum—Official prices on refined, July 29, 30, 31, $115 per oz.; Aug. 2, 3, 4, $116. Cash sales of larger lots at $111@$114. Pure metal as a constituent of crude platinum, $108@$110. The gradually advancing prices have brought out a little more interest in the market, but some think they are artificial.

London, £23½ per oz. for refined, and £21@£22 for crude and scrap. Market dull but firm.

Quicksilver — Per 75-lb. flask, $89. Retail lots of spot metal about $2 higher. Italian offerings have depressed prices. London, £15⅝. San Francisco wires, $89.67.

Radium—$70 per mg. radium content.

Rhodium—Per ounce, $70@$80; London, £14@£17. Nominal.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Ruthenium—Per ounce, $60@$70, nominal. London, £12@£15.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2 per pound in ton lots. London reports good demand at 7s. 6d.

Tantalum—Per pound, $36. Nominal only, as only seller has none to offer in open market.

Tellurium—Per pound, $2.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $10 per lb. in 25-lb. lots.

Tungsten Powder—Per pound, 97 to 98 per cent pure, $1.10@$1.15.

[1]**Zirconium Metal**—Per pound, 98 per cent grade, $30 in 5 to 10 lb. lots.

Metallic Ores

Chrome Ore—Rhodesian and Indian, 47@50 per cent Cr_2O_3, quiet and nominal at $22.50 per long ton, c.i.f. Atlantic seaports. New Caledonian, $25, nominal.

Iron Ore—Lake Superior ores, per long ton, lower Lake ports, established season prices:

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range bessemer, 51½ per cent, $4.55.

High-phosphorus foundry, over 0.18 per cent P, $4.15.

Market for Lake Superior ores has been quiet.

Eastern ores, cents per unit delivered at furnaces: Foundry and basic, 53 to 63 per cent, 9@10½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

Swedish and Norwegian, low-phosphorus, 68 per cent, 10½@10⅝c.

Spanish low-phosphorus, 52@54 per cent, 10@11c.

Algerian, low-phosphorus, 9½@9⅝c.

Spanish foundry or basic, 50@54 per cent, 8¾@9¼c.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

Manganese Ore—Recent sales have been kept confidential to a large extent, but it is rumored that as low as 32c. per long ton unit of Mn, c.i.f. North Atlantic ports, has been done for high-grade ore, 47 per cent Mn minimum. General market probably around 35@36c. Caucasian (washed) 53@55 per cent, 40c.

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80 per ton in carloads.

Molybdenum Ore—Per pound of MoS_2 for 85 per cent MoS_2 concentrates f.o.b. Colorado, 50c. Mostly contract business.

Tantalum Ore—Foreign, 50c. per lb. of Ta_2O_5 contained, c.i.f. New York. Practically none available.

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $10.50@$10.75; Western scheelite, $10.75. Market quiet.

Uranium Ore—Minimum 5 per cent U_3O_8, per pound of U_3O_8 contained, $5, f.o.b. Montrose, Colo. Purely nominal as African production controls the market.

Vanadium Ore—Containing 5 per cent V_2O_5, 25c. per lb. of V_2O_5, f.o.b. Montrose, Colo. Market very slow and Peruvian competition reported to have practically killed the domestic market.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 55@60c. per pound V_2O_5, duty paid, seaboard. Price only nominal as there is no market for offerings.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

Asbestos—F.o.b. *Quebec* mines, tax and bags included, per ton:

Crude No. 1, $525; crude No. 2, $300; spinning fibers, $190; magnesia and compressed sheet fibers, $125@$150; shingle stock, $70; paper stock, $40@$45; cement stock, $25; short fibers, $10@$17.50; floats, $15.

Shipments about normal except for falling off in cement and short grades. Prices unchanged.

No. 1 Rhodesian crude, $325; No. 2, $250 per ton, c.i.f. New York. Market good, with principal producer well sold ahead.

Barytes—F.o.b. mines, per ton, bags extra:

Georgia: Barytes ore, washed, $7.50. Demand good but domestic prices kept at low levels by imports.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $8, f.o.b. mines. Market good for high-grade ore. Poor ore not wanted.

Market in general is firm with good spot sales and withdrawals on contract.

Bauxite—No. 1 chemical ore, over 60 per cent Al_2O_3, less than 5 per cent SiO_2, and less than 2 per cent Fe_2O_3, $8 per long ton, f.o.b. Georgia mines. Good demand but price unstable. Ore should be classified and graded.

Foreign, per metric ton, c.i.f.: Dalmatian, low SiO_2, $5@$6.50; Istrian, $5.50@$7; French, red, $6@$7.50.

Prices are largely nominal, as contracts cover most of the 1926 deliveries.

Borax—Carload lots, in bags, per lb.: crystals, 5c.; granulated or powdered, 4¾c; f.o.b. plant, *Pa.*

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $27 per ton in carload lots.

Chalk—Crude, in bulk, per ton c.i.f. New York, $4.75@$5. No change in foreign situation.

China Clay (Kaolin)—F.o.b. *Virginia* mines, per ton: crude, lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $10@$20; ground, $7@$10.

Florida, pressed pottery, bulk, $13; dry, sprayed, $17; ground, $20. Market slightly dull.

1A grades, domestic, $16@$18, f.o.b. *Delaware* plants. Market slow.

Imported English, f.o.b. American ports: Lumps, $11.50@$19; powdered, $45@$50.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Diatomite—Per short ton, f.o.b. plant, *California:*

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $30; natural aggregate, ¼ in., $20; air-floated powder, $40. Over 85 per cent silica, 98 per cent through 200 mesh, $14.50@$16 depending on quantity; market good.

Emery—F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per pound: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 5½c.; domestic, 3½@4c. Market fair to good.

Feldspar—F.o.b. mine or grinding plant:

North Carolina: No. 1 pottery grade, $6 per long ton. Market dull.

New Hampshire: Pottery grade, $8 per ton; soap grade, $8.75. Market fair.

New York: Per ton, f.o.b. cars, No. 1 crude, $9. Market good.

Maine: No. 1, ground, $19 per ton. Market good.

Tennessee: No. 1 pottery, 140 mesh, $16 per ton; 200 mesh, $18. No. 1 enamel, 140 mesh, $14; 200 mesh, $16. Demand good.

Fluorspar—F.o.b. *Kentucky* and *Illinois* mines, per short ton:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Importers active in Pittsburgh district and are obtaining some business owing to preferential freight rate from seaboard to that district. Domestic producers said to require higher tariff protection to compete. Shipments now reported from Spain, as well as England and Germany. Market generally quiet but firm. Imported fluorspar has sold at $17.50 per ton, duty paid, Atlantic ports.

New Mexico: 85-5 gravel, $15.75; 85-5 lump, $16; 93-3 lump, $23; 96-1½, ground 100 mesh, $45. Demand excellent and producers oversold.

Fuller's Earth—Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 60 to 100 mesh, $15; 100 mesh "up," $8; 200 mesh "up," $15. Market good at unchanged prices.

Powdered, imported, duty paid, $24@$25 per ton.

Garnet—Domestic, per ton f.o.b. mines, $85. Situation easy. Increased supplies of crude available.

Spanish grades, $60, c.i.f. port of entry.

Gilsonite—Per ton, carload lots, f.o.b. mines *Colorado:*

Jet asphaltum, $36; selects, $33; seconds (mine run), $25.50. Market normal.

Graphite—F.o.b. New York, per lb.:

Ceylon lump, 7@9½c.; chip, 6½@8c.; dust, 3½@6½c. Madagascar flake, 6½@7½c.

Market very quiet; prices for imported product lower. Competition severe, with good-sized stocks in the United States.

Flake, 10@30c. according to grade; fine ground crystalline, 4@10c.; amor-

phous ground graphite, 4@8c. Crude amorphous graphite, $15@$35 per ton according to grade, with slight improvement in demand.

Greensand—Per ton, f.o.b. cars, *New Jersey:* screened and bagged, best grade in carload lots, $30. Market very quiet in July.

Gypsum—Per ton f.o.b. mill, depending upon location: Crushed, $2.75@$3; ground, $4@$6; agricultural, $6@$11; calcined, $8@$12.

[1]**Ilmenite**—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. *Virginia* points. $60 per short ton, *Florida* mines.

Iron Oxide (See Ocher)—Standard Spanish red, 3@4c. per lb.; domestic earth, 2@4½c.

Kaolin—See China Clay.

[1]**Lepidolite**—$20@$30 per ton for ordinary grades. Nominal.

Limestone—F.o.b. shipping points, depending on location: either lump or crushed, 90c.@$1.80 per ton.

Agricultural, 75c.@$2 for crushed or pulverized. Prices depend upon source, purity, and fineness.

Magnesite—Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $44; grade B, $38; dead burned, $33; crude, $14. Market not so good.

Mica—F.o.b. plant, per ton:

New Hampshire: Mine run, $360, clean shop scrap, $25@$26; mine scrap, $22. White, dry ground, 20 mesh, $35; 40 mesh, $45; 60 mesh, $60; 100 mesh, $75; 200 mesh, $85. Market not especially good.

Madagascar, amber, dark, free from iron, per lb., f.o.b. *New York*, duty paid: special grade, $3@$3.25; No. A 1, $2.75; No. 1, $2.50; No. 2, $2.20; No. 3, $1.25; No. 4, 65@70c.; No. 5, 40@45c. Grades depend on size of sheets.

[1]**Monazite**—Minimum 6 per cent ThO_2, $120 per ton.

Ocher—F.o.b. *Georgia* mines, per ton: $22.50@$25 in sacks; $25@$30 in barrels; washed and water floated, $25@$28; second grade, 99 per cent through 225 mesh, $19. Market good.

Phosphate—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10. A little more activity in the higher grades.

Florida, pebble, domestic: 76@77 per cent, $6; 75 per cent, $5.25; 74@75 per cent, $5; 70 per cent, $3.50; 68 per cent, $3.10; 66@68 per cent, $3. Market firm but quiet. More activity than usual in 77/6 grade, in which large transactions have taken place.

Tennessee, ground, 95 per cent through 100 mesh, basis 65 per cent B.P.L. (tri-calcium phosphate), $7.25 per short ton, with unit differential of 15c. per ton for all orders booked before June 15, 1926. Since then, $8 per ton, with 20c. differential per unit. Market getting active, with some mills grinding day and night.

Potash—	Bags	Bulk
Muriate of potash 80@85 per cent, basis 80 per cent	$34.90	$33.65
Sulphate of potash 90@95 per cent, basis 90 per cent	45.85	44.60
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	26.35	25.10
Manure salt 30 per cent	21.00	18.00
Manure salt 20 per cent	14.85	11.85
Kainit 14@16 per cent	11.75	8.75
Kainit 12.4 per cent	11.25	8.25

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

Discounts: 5 per cent on minimum of 50 tons K_2O; 6 per cent on 100 tons; 7 per cent on 300 tons; 10 per cent on 500 tons. Prices guaranteed against sellers' decline until April 30, 1927.

Pumice Stone—In barrels, per lb., powdered, 2½@4c.; selected lumps, 5@7c.; lumps in bags, 3@5c.

Pyrites—Tharsis, per long ton unit of sulphur, c.i.f. U. S. ports; guaranteed 48 per cent sulphur, furnace size, 13½c. Cinder from ore to remain property of buyers. Market looking up slightly.

[1]**Quartz Rock Crystals**—Colorless, clear and flawed, pieces ½ to 1 lb. in weight, 40c. per lb. in ton lots. For optical purposes, double above prices.

Silica—Water ground and floated, per ton in bags f.o.b. Illinois: 400 mesh, $31; 350 mesh, $26; 250 mesh, $18. Market fair.

Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$2.50; blast sand, $1.35@$4.

[1]**Spodumene**—$20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$18 per ton for domestic, f.o.b. *Texas* mines; $22 for export, f.a.s. Atlantic ports. Good shipment against contracts. Open prices $1 higher than above.

Talc—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $11; 96 per cent through 200 mesh, medium white, $10; packed in 50-lb. paper bags.

New York: Double air-floated, 100 mesh, $11.25; 200 mesh, $13.75; 325 mesh, $14.75. Demand fair.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9. Market fair.

New Jersey: Soapstone, ground, $9@$11; market good.

Tripoli—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri*: Once ground through 40 mesh: rose and cream colored, $16. Double ground through 110 mesh: rose and cream, $17. Air-floated through 200 mesh: rose and cream, $25; mill run, $15. Unusual summer demand. Largest July in history of the business.

[1]**Zircon**—Freight allowed east of Mississippi River: 95 per cent, 3c. per lb., f.o.b. mines, in carload lots.

Mineral Products

Arsenious Oxide (white arsenic)—3½c. per lb. Glass makers are buying. London, £13@£13¼ per long ton.

Calcium Molybdate—$1.20 per lb. of contained Mo, delivered.

Copper Sulphate—4.90c. per lb. for either large or small crystals. Biggest season since 1922, with tremendous agricultural demand. But little recently imported.

Sodium Nitrate.—Spot, crude $2.45 per 100 lb. ex vessel, Atlantic ports. Futures, $2.33@$2.40.

Sodium Sulphate (Salt Cake)—Per ton, bulk, f.o.b. works, $16@$20.

Zinc Oxide—Per lb. in bags, in car lots: Lead-free, 7½c.; 10, 20 or 35 per cent leaded grades, 7½c.; French, 10½c.

Ferro-Alloys

[1]**Ferrocerium**—Per pound, $5.50.

Ferrochrome—1@2 per cent carbon, 23@25c. per lb. of contained chromium; 4 to 6 per cent carbon, 11½c. per lb. of contained chromium, delivered on contracts. Spot prices 12@12½c. per lb. Market active.

Ferromanganese—Domestic, 78@82 per cent, $88@$90 per gross ton furnace, prompt and future. British product held at $110, seaboard, duty paid, but Norwegian and Canadian offered at competing prices. Spiegeleisen, 19@21 per cent, $32@$34 f.o.b. furnace; 16@19 per cent, $31@$33.

Ferrophosphorus—Electrolytic, 18 per cent P, $91 per ton; 24 per cent, $122.50; f.o.b. Ala. and Tenn.

Ferrosilicon—Per gross ton, f.o.b. works: 50 per cent, $87.50 for spot, delivered in carload lots; 75 per cent, $150 for spot; 14@16 per cent, $45. Heavy shipments.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten—95c.@$1.05 per pound of contained W, f.o.b. works. Market quiet, and said to be demoralized by one or two American producers operating on a toll basis.

[1]**Ferro-uranium**—30 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works in 500-lb. lots.

Ferrovanadium—Per lb. of V contained, f.o.b. works, $3.25@$4, depending on grade and delivery.

Metal Products

Rolled Copper—Sheets, 23c.; wire, 16½c. per lb., f.o.b. mill.

Lead Sheets—Full rolled, 12½c. per lb.; clipped, 12⅝c.

Nickel Silver—30c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Dimension sheets, 20⅜c. per lb.; rods, 17⅜c. per lb.

Zinc Sheets—11¾c. per lb., f.o.b. works.

Refractories

Chrome Brick—$45 per net ton, f.o.b. shipping point.

Fireclay Brick—First quality, $40@$43 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $35@$40.

Magnesite Brick—9-in. straights, $65 per net ton, f.o.b. works.

Silica Brick—$40 per M. Pennsylvania and Ohio; $49@$52 Alabama and Illinois.

[1]**Zirkite**—Powdered, 80 per cent ZrO_2, 2½c. per lb. Brick, straights, 80c.@$1 each.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1925	1926	1925	1926	1925	1926
January	68.447	67.795	32.197	31.322	477.702	485.295
February	68.472	66.773	32.245	30.797	476.886	485.852
March	67.808	65.880	31.935	30.299	477.279	485.606
April	66.899	64.409	31.372	29.682	479.034	485.702
May	67.580	65.075	31.276	30.125	484.960	485.485
June	69.106	65.481	31.863	30.248	485.353	486.000
July	69.442	64.793	31.954	29.861	485.514	485.755
August	70.240	.....	32.268	.....	485.264	.....
September	71.570	.....	32.983	.....	484.270	.....
October	71.106	.....	32.972	.....	483.909	.....
November	69.223	.....	32.155	.....	484.201	.....
December	68.889	.....	31.835	.....	484.538	.....
Year	69.065	.....	32.088	.....	482.426	.....

New York quotations cents per ounce troy, 999 fine, foreign silver. London pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1925	1926	1925	1926	1925	1926
January	14.709	13.822	66.065	59.013	70.607	65.325
February	14.463	13.999	64.714	59.669	69.525	66.375
March	14.004	13.859	62.892	58.603	67.739	65.489
April	13.252	13.706	60.575	57.200	64.194	64.600
May	13.347	13.599	60.131	56.494	63.560	64.313
June	13.399	13.656	59.899	56.778	63.369	64.591
July	13.946	13.924	61.467	57.864	65.750	65.625
August	14.490	.....	61.613	.....	68.169	.....
September	14.376	.....	61.886	.....	67.693	.....
October	14.300	.....	61.977	.....	67.523	.....
November	14.353	.....	61.280	.....	67.893	.....
December	13.866	.....	59.540	.....	65.625	.....
Year	14.042	.....	61.920	.....	66.804	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London		
	1925	1926	1925	1926	1925	1926	1926 3 M
January	10.169	9.255	9.953	9.102	41.443	34.778	34.584
February	9.428	9.154	9.126	8.991	37.944	33.903	33.903
March	8.914	8.386	8.578	8.165	36.804	31.625	31.921
April	8.005	7.971	7.662	7.764	32.791	28.775	29.284
May	7.985	7.751	7.780	7.538	32.283	28.253	28.731
June	8.321	8.033	8.024	7.876	33.479	29.986	30.142
July	8.151	8.499	8.054	8.383	34.698	31.716	31.545
August	9.192	.....	9.284	.....	38.188	.....	.....
September	9.508	.....	9.303	.....	38.884	.....	.....
October	9.513	.....	9.299	.....	39.017	.....	.....
November	9.739	.....	9.578	.....	36.872	.....	.....
December	9.310	.....	9.157	.....	34.739	.....	.....
Year	9.020	.....	8.817	.....	36.429	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1925	1926	1925	1926	1925	1926
January	57.692	61.415	58.250	2.275	265.560	282.038
February	56.517	62.653	57.068	63.705	262.181	287.107
March	53.038	63.472	53.733	64.505	245.682	292.288
April	51.380	61.962	52.135	63.389	237.006	281.388
May	53.675	60.165	54.620	62.305	245.476	270.125
June	54.885	58.409	55.957	60.611	252.476	268.352
July	56.683	61.365	58.014	63.091	258.435	282.102
August	56.649	.....	58.190	.....	258.538	.....
September	56.405	.....	58.247	.....	259.182	.....
October	60.462	.....	62.274	.....	277.722	.....
November	62.136	.....	63.304	.....	284.506	.....
December	61.952	.....	62.928	.....	284.920	.....
Year	56.790	.....	57.893	.....	260.974	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London		
			1925		1926
	1925	1926	Spot	1926	3 M
January	7.738	8.304	37.917	38.059	37.363
February	7.480	7.759	36.528	36.053	35.956
March	7.319	7.332	35.741	34.090	34.247
April	6.985	7.001	34.644	32.503	32.853
May	6.951	6.821	34.223	32.038	32.413
June	6.990	7.112	34.149	33.244	33.398
July	7.206	7.411	34.894	34.045	34.270
August	7.576	.....	36.691	.....	.....
September	7.753	.....	37.435	.....	.....
October	8.282	.....	39.884	.....	.....
November	8.614	.....	39.039	.....	.....
December	8.565	.....	38.327	.....	.....
Year	7.622	.....	36.624	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York
	1925	1926	1925	1926	1925	1926	1926
January	17.428	23.490	81.596	87.960	117.000	118.200	113.20
February	19.795	21.676	79.386	87.580	117.000	113.909	108.341
March	15.553	19.708	80.481	88.194	117.000	112.000	106.278
April	12.553	17.462	82.327	89.769	118.269	111.538	103.731
May	15.770	12.170	81.360	91.365	119.850	108.960	102.930
June	16.500	11.106	83.154	91.346	120.000	111.000	106.615
July	17.779	14.490	83.077	90.163	120.000	114.692	109.000
August	17.683	.....	82.317	.....	120.000	.....	.....
September	17.143	.....	81.730	.....	120.000	.....	.....
October	18.029	.....	83.856	.....	120.000	.....	.....
November	20.000	.....	88.250	.....	120.000	.....	.....
December	21.692	.....	90.000	.....	120.000	.....	.....
Year	17.494	.....	83.128	.....	119.093	.....	.....

(a) Antimony quotations in cents per pound for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1925	1926	1925	1926	1925	1926
January	24.66	22.76	23.76	21.76	23.76	22.26
February	24.50	22.76	23.26	21.76	23.76	22.26
March	24.06	22.76	23.06	21.76	22.91	22.26
April	22.89	21.38	21.76	20.66	22.26	21.05
May	21.57	21.12	20.26	19.76	21.16	20.76
June	20.76	20.76	19.76	19.76	20.11	19.80
July	20.76	20.44	19.76	19.26	20.26	19.49
August	20.76	.....	19.76	.....	20.26	.....
September	21.04	.....	20.03	.....	20.50	.....
October	21.50	.....	20.37	.....	20.83	.....
November	22.64	.....	21.58	.....	22.08	.....
December	22.76	.....	21.76	.....	22.26	.....
Year	22.33	.....	21.26	.....	21.68	.....

In dollars per long ton.

Monthly Crude Copper Output in Short Tons

Domestic

	1926					
	Jan.	Feb.	March	April	May	June
Alaska shipments	3,644	2,556	3,150	3,597	1,797	4,059
Butte & Superior	.....	.....	1,243†	.....	.....	.....
Calumet & Arizona	1,737	1,795	2,010	1,938	2,454	2,104
Magma	1,208	1,095	1,255	1,200	1,228	1,208
Miami	2,228	2,109	2,336	2,302	2,298	2,241
New Cornelia	3,664	2,986	3,541	3,634	2,723	3,543
Nevada Con	.....	.....	9,774†	.....	.....	.....
Old Dominion	1,291	1,080	1,111	1,132	1,173	1,058
Phelps Dodge	7,586	6,949	7,449	7,033	7,566	6,786
Ray Con	.....	.....	17,840†	.....	.....	.....
United Verde Extension	1,987	1,764	1,784	1,730	1,997	1,908
Utah Copper	.....	.....	26,736†	.....	.....	.....
Tennessee Copper	555	503	543	520	555	521

Foreign

Boleo, Mexico	771	820	898	910	935	1,008
Furukawa, Japan	1,409	1,386	1,586	1,708	1,513	.....
Granby Cons., Canada	1,438	1,482	1,763	1,583	1,700	.....
Union Minière, Africa	6,827	6,810	7,097	7,050	7,547	7,427
Mount Lyell, Aust	.....	.....	2,002†	.....	.....	1,695
Sumitomo, Japan	1,188	.....	.....	.....	.....	.....

†Three months.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1924		1925		1926	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	66,631	2,149	74,789	2,412	71,026	2,291
February	65,681	2,265	68,967	2,463	68,131	2,433
March	65,181	2,102	74,901	2,416	75,728	2,443
April	66,073	2,202	71,667	2,356	73,454	2,448
May	65,608	2,116	70,574	2,276	73,542	2,372
June	63,933	2,131	59,894	2,330	70,707	2,357
July	64,787	2,090	68,507	2,210	.....	.....
August	66,756	2,153	68,090	2,196	.....	.....
September	63,800	2,127	67,720	2,272	.....	.....
October	68,989	2,225	71,042	2,292	.....	.....
November	68,291	2,276	67,400	2,247	.....	.....
December	67,647	2,182	69,566	2,244	.....	.....
Total	793,377	.....	842,117	.....	432,588	.....
Monthly average	66,115	.....	70,176	.....	72,098	.....
Average of daily rate	.....	2,168	.....	2,307	.....	2,390

Company Reports

U. S. Steel's Earnings Increase in Second Quarter

The United States Steel Corporation gave sound grounds for the recent advance in its securities on the stock market, by reporting increased profits for the second quarter of 1926. Net earnings for that period amounted to $47,814,105, comparing with $45,061,285 in the first quarter and $40,624,221 in the second quarter of 1925. Surplus available for common dividends was equal to $4.20 a share, though only the usual dividend of $1.75 was declared. The monthly earnings during the second quarter, compared with the same months last year, were as follows:

	April	May	June
1925	$13,376,821	$13,803,453	$13,443,947
1926	15,705,202	16,159,866	15,949,037

Though monthly earnings were about $2,500,000 greater this year than last, the trend from month to month was practically the same.

Transvaal Gold Output at New High in June

Supplementing the figures for Transvaal gold output published on page 197 of the July 31 issue of *Engineering and Mining Journal*, the report for June shows a total of 852,145 oz., or about 3,000 oz. in excess of May, in spite of the shorter month. However, there were five Sundays in May and only four in June. The new record is commented on editorially in this issue.

Earnings and Dividends of American Metal Nearly Balance

The net profit of the American Metal Co. for the quarter ending June 30, 1926, was $690,485, or $1.01 a share after allowing for preferred dividends. The common dividend is $1 a share, and has been declared, payable Sept. 1. Net profit of the company for the first quarter of the year was $702,668, or $1.03 a share on the common; and for the second quarter of 1925, $1,078,300, equal to $1.67 a share on the common stock.

Calumet & Hecla Making Slim Profit

The quarterly report of the Calumet & Hecla Consolidated Copper Co., operating in Michigan, for the period ended June 30, 1926, shows a net profit of $161,765 after taxes, depreciation, and depletion, this being considerably better than in the preceding quarter, when a net loss of $54,322 was registered, or in the second quarter of 1925, when the loss was $405,690. The second quarter's earnings were equivalent to 8c. a share; and for the first half of the year, to 5c. a share.

Texas Gulf Surphur to Have "No Par" Stock

The stockholders of Texas Gulf Sulphur Co. will vote on Sept. 9 on a plan to change the capitalization of the company from 635,000 shares of $10 par, to 2,540,000 shares without par value. This means a split-up of four for one. Harvey S. Mudd has been elected to take his father's place on the board of directors, Seeley W. Mudd having died on May 24.

Imports and Exports of Ores and Metals in June, 1925 and 1926

Compiled from the U. S. Department of Commerce Records

In pounds unless otherwise stated

Imports

	June, 1925	June, 1926
Antimony		
Ore, Gross weight	70,410	609,686
Ore, Antimony content	56,328	579,362
Liquated regulus or metal	1,402,816	1,847,025
Copper		
Ore	10,133,717	4,837,468
Concentrates	5,249,966	2,737,289
Regulus, coarse metal, cement copper	.....	.....
Imported from		
Spain	488,030	1,095,856
Canada	1,936,186	2,369,635
Mexico	2,051,180	2,317,700
Cuba	4,128,320	17,248
Chile	6,301,429	1,580,214
Peru	295	109,898
Other countries	478,243	84,266
Unrefined black, blister converter copper in pigs.	24,077,729	39,580,903
Imported from		
United Kingdom	21,353	.....
Canada	3,792,221	597,188
Mexico	3,895,623	5,114,172
Chile	2,375,583	9,690,459
Peru	4,503,223	14,992,353
Portuguese Africa	8,947,868	8,054,776
France	541,858	1,131,955
Refined copper	6,700,754	14,318,399
Old and clippings for remanufacture	386,479	1,001,280
Composition metal, copper chief value	.....	10,096
Brass		
Old and clippings for remanufacture	618,413	668,384
Lead		
Ore and matte	6,777,343	3,806,033
Bullion or base bullion	7,197,402	12,472,143
Pigs and bars	112,049	896,018
Scrap lead, babbitt metal, solder, and other forms (lead content)	148,694	206,827
Type metal and antimonial lead, Gross weight	.....	442,220
Type metal and antimonial lead, Lead content	.....	333,165
Manganese ore, tons, Gross weight	64	13
Manganese ore, tons, Manganese content	17,020	31,315
Pyrites, tons	15,478	29,140
Tin		
Ore, tons	18	16
Bars, blocks and pigs	15,646,612	16,195,919
Imported from		
United Kingdom	2,732,782	4,582,582
British Malaya	10,708,743	7,164,334
China	.....	56,122
Dutch East Indies	23,370	291,638
Hongkong	1,834,280	1,729,486
Australia	33,600	112,000
Other countries	313,837	2,269,757
Zinc		
Ore, zinc content	661,718	1,011,099
Blocks, pigs and old	25	1,885

Exports of Copper, Lead and Zinc

	June, 1925	June, 1926
Copper		
Ores, concentrates, composition metal and unrefined	293,332	472,291
Refined in ingots, bars, and other forms	96,651,953	77,379,112
Exported to		
Belgium	7,636,906	5,570,712
France	14,215,167	16,035,779
Germany	20,404,161	14,621,211
Italy	14,650,423	9,059,834
Netherlands	8,108,617	5,213,545
Spain	537,774	2,183,900
Sweden	3,906,553	1,883,468
United Kingdom	18,000,946	17,542,842
Other Europe	392,778	508,806
Canada	3,350,506	1,366,877
British India	308,238	357
China	2,749,078	168,177
Japan	1,623,917	2,723,440
Other countries	766,889	500,164
Old and scrap	1,229,341	2,070,993
Pipes and tubes	123,056	222,619
Plates and sheets	2,445,270	187,225
Rods	4,771,745	3,285,082
Wire	668,829	1,749,226
Insulated copper wire and cable	1,005,351	1,658,069
Lead		
In pigs, bars, and other forms		
From domestic ore	511,482	210,663
From foreign ore	17,600,449	16,341,389
Exported to		
Belgium	224,081	560,107
France	1,904,585	1,635,595
Germany	3,528,936	3,024,753
Italy	616,066	.....
Netherlands	1,254,762	.....
United Kingdom	8,904,820	1,680,289
Other Europe	336,169	672,122
Argentina	380,841	56,350
Brazil	672,515	627,554
Japan	.....	6,777,830
Other countries	289,156	1,517,452
Other lead manufactures	634,090	2,373,712
Zinc		
Ore and concentrates, tons	360	11,447
Dross	1,994,363	2,217,113
Cast in slabs, blocks, or pigs	10,363,661	10,311,176
Exported to		
Belgium	280,008	313,704
France	1,545,959	1,117,835
Germany	628,156	1,323,415
Italy	2,803,982	336,134
Netherlands	414,475	123,228
United Kingdom	3,153,887	3,526,093
Other Europe	224,121	.....
Argentina	896,450	.....
British India	114,300	291,211
Other countries	305,323	3,279,556
Sheets, strips, other forms	540,021	1,647,415
Dust	274,498	195,581
Other zinc manufactures	34,398	118,594

Mining Stocks—Week Ended July 31, 1926

Stock	Exch.	High	Low	Last		Last	Div.
COPPER							
Anaconda	New York	50⅜	49	49⅞	Jy.17, Au.23	Q	0.75
Arcadian Consol.	Boston	1⅛	1	1⅛			
Ariz. Com'l	Boston	12	11½	11⅝	Jy. 16, Jy. 30		0.50
Calaveras	N. Y. Curb	1⅜	1⅜	1⅜			
Calumet & Arizona	New York	69½	68	69½	Jn. 4, Jn. 21	Q	1.50
Calumet & Hecla	Boston	15⅞	15½	15⅝	Jn. 1, Jn. 15	Q	0.50
Cerro de Pasco	New York	70½	67⅞	69½	Jy. 15, Au. 2, Q		1.00
Chile Copper	New York	34½	33⅜	34	Sept. 1, Sept. 27,	Q	0.62½
Chino	New York	....	....	22⅞	Sept., 1920		0.37½
Con. Coppermines	N. Y. Curb	3½	3½	3½			
Copper Range	Boston	17⅞	16⅞	17⅛	May, 1925		1.00
Crystal Copper	Boston Curb	*32	*30	*32			
East Butte	Boston	3⅝	3⅜	3⅜	Dec., 1919		0.50
First National	Boston Curb	*22	*22	*22	Feb., 1919		0.15
Franklin	Boston	....	....	*60			
Granby Consol.	New York	23⅛	22½	23⅛	May, 1919		1.25
Greene-Cananea	New York	22	19⅝	20⅞	Nov., 1920		0.50
Hancock	Boston	*80	*80	*80			
Howe Sound	New York	38¼	37½	37⅞	Ap.1, Ap.15		0.75
Inspiration Consl.	New York	25½	25	25⅛	Jn.7, Jy.6,	Q	0.50
Iron Cap	Boston Curb	4	3½	3⅝	Jn. 1, Jn. 15		0.50
Isle Royale	Boston	12⅞	12⅝	12⅝	Jn. 1, Jn. 15		0.50
Jerome Verde Dev.	N. Y. Curb	*58	*58	*58			
Kennecott	New York	56⅛	55⅛	56⅛	Sept. 3, Oct. 1	Q	1.00
Lake Copper	Boston	1½	1⅛	1½	June, 1925		0.50
Magma Copper	New York	41½	40	40⅛	Jn.30, July. 15,	Q	0.75
Mason Valley	N. Y. Curb	1⅜	1⅜	1⅜	Nov., 1917		1.00
Mass Consolidated	Boston	*75	*75	*75	Aug.2, Aug.16	Q	0.25
Miami Copper	New York	15	14⅛	14⅞	Jy.31, Se.1	Q	1.00
Mohawk	Boston	40⅛	38	39⅛	Jn. 15, Jn. 30		0.37½
Mother Lode Cos.	New York	6⅛	6	6	Jn. 15, Jn. 30	Q	0.25
Nevada Consol.	New York	13⅜	13⅛	13⅛	Au.6, Au.23	Q	0.04
New Cornelia	Boston	23	22	22⅛	Oct., 1918		0.25
North Butte	Boston	2⅞	2⅛	2⅛	No. 14, De. 2		0.05
Ohio Copper	N. Y. Curb	*60	*56	*56	Dec., 1918		1.00
Old Dominion	Boston	19	18	19	Jun.22, July2	Q	1.50
Phelps Dodge	Open Mar.	†126	†123	....	Mar., 1920		1.00
Quincy	Boston	24	22	23⅛	Ap.20, Ap.30		0.25
Ray Consolidated	New York	14⅛	13⅜	14			
Ray Hercules	N. Y. Curb	....	....	11⅞	Dec., 1917		0.30
St. Mary's Min. Ld.	Boston	33	30½	31⅝	Ap.17, My.18		2.00
Seneca Copper	New York	6½	6	6½			
Shannon	Boston	*65	*50	*65	Nov., 1917		0.25
Superior & Boston	Boston	*75	*65	*75			
Tenn. C. & C.	New York	12⅛	11⅝	12⅛	My. 29 Ju.15,	Q	0.25
United Verde Ex.	N. Y. Curb	29⅛	28	28⅜	Jy.17, Aug. 2,		0.75
Utah Copper	New York	....	....	103	Jn.15, Jn.31,	Q	1.25
Utah Metal & T.	Boston	1⅜	1⅜	1⅜	Dec., 1917		0.30
Victoria	Boston	*50	*50	*50			
Walker Mining	Salt Lake	....	....	*53			
NICKEL-COPPER							
Internat. Nickel	New York	39⅜	37⅛	38	Je.17, Je.30,		0.50
Internat. Nickel, pfd.	New York	....	....	104	Jy.12, Au.2,		1.50
LEAD							
Gladstone M. M. Co.	Spokane	*29½	*28½	*29	Jn. 10, Jy.10		0.01
National Lead	New York	160¼	156¾	156¾	Jn. 11, Jn. 30	Q	2.00
National Lead pfd.	New York	....	....	116¾	My.21, Je.15	Q	1.75
St. Joseph Lead	New York	42¼	41⅞	42	Jn.10, Jn.21	QX	0.75
ZINC							
Am. Z. L. & S.	New York	7⅜	7⅛	7⅛	May., 1920		1.00
Am. Z. L. & S, pfd.	New York	36⅛	34	36	Nov., 1920		1.50
Butte C. & Z.	New York	5⅜	5⅛	5⅜	De.10, De.24		0.50
Butte & Superior	New York	11½	10⅜	10⅜	Jn.15, Jn.30	Q	0.50
Callahan Zn-Ld	New York	1⅜	1⅛	1⅛	Dec., 1920		0.50
Eagle Picher	Cincinnati	32	31	31⅛	Sept.10, Sept.30	Q	2.00
Eagle Picher, pfd.	Cincinnati	....	....	110	Aug.20, Sept.15	Q	1.75
New Jersey Zn.	N. Y. Curb	....	....	208	July20, Aug.10	Q	2.00
United Zinc	N. Y. Curb	....	....	*70			
Yellow Pine	Los Angeles	....	....	*25	De.8, De.18	Q	0.04
GOLD							
Alaska Juneau	New York	1½	1½	1½			
Argonaut	Toronto	*23	*20	*20½			
Barry-Hollinger	Toronto	*53½	*47½	*51			
Carson Hill	Boston	....	....	*22			
Consol. W. Dome L.	Toronto	*17	*14½	*15¼			
Cresson Consol. G.	N. Y. Curb	2⅛	2⅛	2⅛	Mh.31, Ap.10		0.10
Crown Reserve	Toronto	*10	*9½	*9½	Jan., 1917		0.05
Dome Mines	New York	11	10⅛	11	Jn.30, July 20,	Q	0.50
Golden Center	N. Y. Curb	3	1⅞	2⅛			
Golden Cycle	Colo. Springs	....	....	1.52	No.30, Dec.10	Q	0.03
Hollinger Consol.	Toronto	19.75	19.40	19.40	Jy.27, Au.12	M	0.10
Homestake Mining	New York	....	....	54	Jy.20, Jy.26	M	0.50
Kirkland Lake	Toronto	1.00	*92	*94½			
Lake Shore	Toronto	12.40	12.05	12.05	Jn.1, Jn. 15	Q	0.10
McIntyre-Porcupine	New York	25⅛	25⅛	25⅛	Au. 2, Se.1	Q	0.25
Newray	Toronto	*33	*33	*33			
Noranda	N. Y. Curb	17⅛	16⅝	16⅞			
Night Hawk Pen	Toronto	*8	*8	*8			
Portland	Colo. Springs	....	....	*43½	July6, July15		0.02
Premier Paymaster	Toronto	2.18	2.12	2.16			
Rand Mines	New York	....	....	34⅛	Fe.16, Fe.26		1.52
Teck-Hughes	Toronto	3.89	3.83	3.88	Jy. 15, Au. 2		0.05
Tom Reed	Los Angeles	*61	*60	*60	Ma.10 Ma.20		0.02
Tough-Oakes	Toronto	*39½	*38	*39			
United Eastern	N. Y. Curb	*30	*30	*30	July, 1924		0.05
Vipond Cons.	Toronto	1.80	1.74	1.77			
Wright-Hargreaves	Toronto	8.48	8.40	8.45	Jn.15, Jy.1	QX	0.07½
Yukon-Alaska Trust	N. Y. Curb	....	....	21			
GOLD AND SILVER							
Carnegie Metals	Boston	....	....	14			
Con. Cortez	N. Y. Curb	*6	*6	*6			
Con. Virginia	San Francisco	*8½	*6½	*8			
Continental Mines	N. Y. Curb	....	....	*45			
Dolores Esperanza	N. Y. Curb	....	....	*40	July, 1923		0.05
Premier Gold	N. Y. Curb	2 3/16	2 1/16	2 1/16	Jn.18, Jy.3	Q	0.08
Tonopah Belmont	N. Y. Curb	3 3/16	3	3 3/16	Se.15, Oc.1		0.05
Tonopah Extension	N. Y. Curb	*50	*50	*50	Apr. 1925		0.05
Tonopah Mining	N. Y. Curb	7	6⅜	6⅝	Ap.7, Ap.21	Q	0.07½
Unity Gold	N. Y. Curb	....	....	*30			
West End Consol.	N. Y. Curb	*18	*18	*18	Mar., 1923		0.05
Yukon Gold	N. Y. Curb	...	...	*30	June, 1918		0.02

Stock	Exch.	High	Low	Last		Last	Div.
SILVER							
Alvarado	N. Y. Curb	....	....	1	Oct., 1920		0.50
Beaver Consol.	Toronto	*78	*75	*75	May. 1920		0.03
Castle-Trethewey	Toronto	1.54	1.51	1.52			
Coniagas	Toronto	3.85	3.70	3.70	May, 1924		0.12½
Keeley	Toronto	1.71	1.65	1.66	Ma.1, Ma.15	X	0.12
Kerr Lake	N. Y. Curb	1	1	1	Ap.1, Ap.15		0.12½
La Rose	Toronto	*10½	*9½	*10	Apr., 1922		0.10½
Lorrain Trout Lake	Toronto	....	....	*85	Jy. 2, Jy. 15		0.05
McKinley-Dar.-Sav.	Toronto	*14	*12½	*14	Oct., 1920		0.03
Mining Corp. Can.	Toronto	4.24	3.93	4.16	Jy.1, Jy.15		0.12½
Nipissing	N. Y. Curb	5⅜	5¼	5¼	Jn.30, Jy.20		0.15
Temiskaming	Toronto	....	....	*11	Jan., 1920		0.40
SILVER-LEAD							
Ahumada	New York	8¼	8	8¼	Jn.18, Jy.5,	Q X	0.25
Alta Merger	Salt Lake	†*5½	†*2½	....			
Bingham Mines	Boston	33	31½	31½	Jn.19, Jn.30	Q	1.00
Cardiff M. & M.	Salt Lake	....	....	*50	De.16, No.18		0.10
Chief Consol.	Salt Lake	....	....	3.40	Jy.10, Au 10	Q	0.10
Cleveland-Cliffs Iron	Cleveland	†80	†75	....			
Emma Silver	Salt Lake	†1	†*50	....			
Erupcion	Boston Curb	1⅜	1½	1⅜	Jn.18, Jy.5,	QX	0.10
Federal M. & S.	New York	81	80½	81			
Federal M. & S., pfd.	New York	74	72	73½	My.25, Ju.15	Q	1.75
Hawthorne Mines	N. Y. Curb	*15	*12	*14			
Hecla Mining	N. Y. Curb	18¼	17¾	17¾	My.15, Je.15	Q	0.50
Iron King Mining	Salt Lake	†*27	†*24	....			
Keystone Mining	Salt Lake	†*30	†*26	....	Au.12, Au.26		0.07½
Lucky Jim	Spokane	*16	*15½	*16			
Lucky-Tiger Combination	Kansas	†9.40	†9.25	....			
Mammoth Mining	Salt Lake	2.75	2.75	2.75	Mar.24, Apr. 1		0.10
Marsh Mines	Spokane	*2⅞	*2½	2⅜	Se.15, Oc.1		0.15
Park Utah	New York	6.80	6.70	6.75	Jn.15, Jy.1	Q	0.15
Prince Cons.	Salt Lake	....	....	1			
Silver King Coal	Salt Lake	....	....	9.05	Jn. 21, July 1,	Q	0.25
Silversmith	Spokane	*47½	*45½	*47½	Jn.30, Jy.10	Q	0.02
Tamarack-Custer	Spokane	*30	*27½	*29	Sept., 1924		0.25
Tintic Standard	Salt Lake	....	....	12.37½	Jn.16, Jn.26,		0.40
Utah-Apex	Boston	8	7⅞	8	Jy. 3, Jy.15	Q	0.25
Western Utah Copper	N. Y. Curb	...	...	*8			
IRON							
Bethlehem Steel	New York	47	44⅜	46⅜	July, 1924		1.25
Colorado Fuel & Iron	New York	45⅞	44⅜	45	May, 1921		0.75
Gt. North'n Iron Ore	New York	20⅛	19⅜	19⅜	De. 4, De. 28,		0.75
Inland Steel	New York	...	...	41	My.10, Je.1	Q	0.75
Mesabi Iron	N. Y. Curb	1⅜	1⅜	1⅜			
Replogle Steel	New York	10¼	10	10¼			
Republic I. & S.	New York	59	57	58	Au.14, Se.1		1.00
Republic I. & S. pfd.	New York	97½	96⅞	97⅞	Se.15, Oc.1	Q	1.75
Sloss-Sheffield S. & I.	New York	134⅜	122	123	Jn.10, Jn.21	Q	1.50
Sloss-Shef. S.&I. pfd.	New York	105½	104	105½	Jn.21, July 1,	Q	1.75
U. S. Steel	New York	149¼	137⅜	146½	Se.2, Se.29	Q	1.75
U. S. Steel pfd.	New York	130	129⅜	130	Au.3, Au.30,	Q	1.75
Virginia I. C. & C.	New York	...	...	43	Jan., 1924		1.50
Virginia I.C.&C.pfd	New York	...	...	70	Jn.1, July 2,		2.50
ALUMINUM							
Alum. Co. of Amer.	N.Y. Curb	70	69	70			
Alum. Co. of Amer pf.	N.Y. Curb	101¼	101¼	101½	June 15, July 1,	Q	1.50
VANADIUM							
Vanadium Corp.	New York	36½	35¼	36½	Au.2, Au.16,	Q	0.75
ASBESTOS							
Asbestos Corp., New	Montreal	18¼	16⅞	16⅞	De.31, Ja.15	Q	1.50
Asbestos Corp., pfd.	Montreal	72	65	67	Jy.1, Jy.15,	Q	1.75
SULPHUR							
Freeport Texas	New York	32⅛	29⅞	30½	Nov., 1919		1.00
Texas Gulf	New York	169½	156½	164½	Jn. 1, Jn. 15,	Q	2.50
DIAMONDS							
De Beers Consol.	New York	....	....	35¼	Ju.16, Ju.17		1.70
PLATINUM							
So. Am. Gold & P.	N. Y. Curb	5¼	5	5			
MINING, SMELTING, REFINING AND GENERAL							
Amer. Metal	New York	53⅜	52	52	Au.20, Se. 1,	Q	1.00
Amer. Metal pfd.	New York	117	117	117	Au.21, Se. 1	Q	1.75
Amer. Sm. & Ref.	New York	134½	127⅜	133⅜	Jy.10, Au.2,	Q	1.75
Amer. Sm.&Ref.pfd.	New York	120	119¼	120	Au.7, Se.1,	Q	1.75
Consol. M. & S.	N. Y. Curb	....	....	208	Jn.30, Jy.5	QX	3.75
Federated Metals	N. Y. Curb	13	13	13			
Newmont Mining	N. Y. Curb	67¼	64⅜	66	Mar.31, Apr.15,		0.60
Southwest Metals	N. Y. Curb	....	....	1	Jn.30, Jy.15		0.60
U. S. Sm. R. & M.	New York	40½	40½	40½	Jy. 7, Jy. 15,	Q	0.87½
U. S. Sm. R.&M.pfd.	New York	49¼	49	49¼	Jy. 7, Jy. 15,	Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED JULY 21, 1926

Name	High	Low	Last	Last Divd. Date	Amount
Aramayo Mines (25 frs.)	81/3	80/—	80/—	May. 1926	5 p.c.†
British Platinum (£1)	5/7½	5/—	5/—	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	16/—	15/6	15/9	Aug. 1926	7 annas*
Bwana M'Kubwa (5s)	7/9	7/3	7/7½		
Camp Bird (£1)	4/10½	4/—	4/4½		
El Oro (£1)	9/3	8/3	8/3	Nov. 1924	2½ p.c.*
Esperanza (10s)	1/1½	—/10½	1/—		
Frontino & Bolivia (£1)	7/7½	6/3	6/3	July 1926	2½ p.c.
Mexican Corpn. (£1)	16/—	15/6	15/6	Dec. 1925	12½ p.c.*
Mexico Mines of El Oro (£1)	27/6	25/—	25/—	June 1926	7½ p.c.*
Oroville Dredging (£1)	4/—	3/10½	3/9	Dec. 1923	3¾ p.c.
Ouro Preto (£1)	2/1½	2/—	2/—	May 1925	2½ p.c.
Rhodesian Congo Border	120/7½	115/—	117/6		
St. John del Rey (£1)	9/—	8/1½	8/9	June 1925	6¼ p.c.
San Francisco Mines (10s)	30/10½	29/6	30/—	June 1926	15 p.c.
Santa Gertrudis (£1)	19/3	18/4½	18/9	July 1926	5 p.c.
Selukwe (2s. 6d.)	13/6	12/4½	13/—	April 1917	6¼ p.c.
S. Amer. Copper (2s.)	4/4½	4/1½	4/4½	Nov. 1917	75 p.c.
Tanganyika (£1)	39/4½	35/—	36/3	Sept. 1925	5 p.c.
Tomboy (£1)	4/—	3/9	3/9	July 1926	10 p.c.
Union Miniere du Haut-Katanga (Brussels)	10.500	9.300	10.250	July 1926	178 frs.‡

* Free of British income tax. † Swiss frs. ‡ Belgian frs.